COMING EVENTS

Public Observing
Sunday Feb. 24
Prairie Park Nature Center
8:00 PM

Monthly Meeting
INTO DEEPEST SPACE
The Birth of the ALMA Observatory
Friday FEB. 15
7:30 PM, 2001 Malott

President
Rick Heschmeyer
rcjbm@sbcglobal.net

University Advisor
Dr. Bruce Twarog
btwarog@ku.edu

Webmaster
Howard Edin
howard@howardedin.com

Observing Clubs
Doug Fay
dfay@ku.edu
ALCOR
William Winkler
billwink10@yahoo.com

Japanese Tree Rings Show Signs Of Gamma Ray Burst From Colliding Stars Or Black Holes, Scientists Say

More than 1,200 years ago, some mysterious event was recorded in tree rings in a Japanese cedar forest. While one study suggested a solar flare was to blame (see this column last month), a new group of researchers are pointing toward a gamma-ray burst, a powerful space explosion.

The ancient cedar trees record a rare event around 774 or 775 A.D. This shows up in a sharp rise in the amount of radioactive carbon-14 and beryllium-10 recorded in the trees' rings, which can be created by incoming particles from space.

But what caused an influx of radiation?

According to astronomers Valeri Hambaryan and Ralph Neuhauser of the Astrophysics Institute of the University of Jena in Germany, the most likely culprit was a gamma-ray burst. These bursts can be caused when two compact objects, such black holes or neutron stars, slam into each other and release a flood of high-energy gamma-ray radiation.

Such an interpretation, the scientists argue, fits the tree ring mystery, because a gamma-ray burst would be powerful enough to cause the uptick in carbon-14 and beryllium-10. It also fits with the fact that no rare celestial event was observed that year on Earth, at least according to records available now. The researchers calculated that a gamma-ray burst at a distance of 3,000 and 12,000 light-years from Earth best fits the data.

"If the gamma-ray burst had been much closer to the Earth it would have caused

TELESCOPE IN SEARCH OF A HOME

The club was contacted recently by a resident of Eudora who has inherited a telescope which she would like to donate to someone who will put it to good use, i.e. observe the sky with it. The scope is an EDSCORP C2058. These were scopes manufactured by Edmund Scientific back in the late 50’s for use by amateurs. It is similar to this model on Ebay: http://ebay.superlot.ru/?s=item&id=200738142986.

The scope was taken apart for storage, so some assembly is required. The owner believes that the scope is complete and is mostly in need of some cleaning before assembly. If interested, contact Bruce Twarog at btwarog@ku.edu.

(Continued on page 2)
The Mid States Regional Convention of the Astronomical League (MSRAL) has been set for Omaha on Fri./Sat. May 17/18. For more info, check out their web page at http://msral2013.org.

The Astronomical League has added another observing program for your viewing and educational enjoyment. The Observe Stellar Evolution Program will introduce you to 100 objects in various stages of evolution. The program has an observing manual, packed full of interesting information along with selected celestial objects to enforce the evolutionary nature of the cosmos. By completing this program, you will have a better understanding of the Hertzsprung-Russell Diagram and how the 100 objects of this program fit on the diagram. For more information, visit the Observe Stellar Evolution Program's web page.

Everything that you see in the night sky is visible to you because of light from a star. The stars themselves, nebulae, planets, moons, are visible because of starlight. Even dark nebulae are visible because they block the illumination of stars or other objects lit up by stars. We exist because early generations of stars generated the elements that make up our planet and the chemical elements required for life. It is not an understatement to say that we exist because stars exist. The Observing Stellar Evolution club will be of interest to beginning observers as well as more experienced observers. The purpose of this club is to develop in the observer an appreciation for the most common objects that they see in the night sky – stars. Stars, like us, are born, live their lives and end their lives. Understanding this 'stellar evolution' is important to understanding how the universe works.

Any suggestions for improving the club or the newsletter are always welcome.

The rare forms of carbon and beryllium, which are heavier than the normal varieties of those elements, are created when radiation from space collides with nitrogen atoms in Earth's atmosphere, which then decay into carbon-14 and beryllium-10. Both chemicals are unstable and decay on predictable time scales, allowing scientists to trace these particular tree rings back to such a specific time in the past. The fact that the jump in carbon-14 and beryllium-10 was only seen in one year's rings means whatever sparked their creation was short-lived.

"The challenge now is to establish how rare such carbon-14 spikes are, i.e., how often such radiation bursts hit the Earth," Neuhauser said. "In the last 3,000 years, the maximum age of trees alive today, only one such event appears to have taken place." The researchers say a gamma-ray burst explanation fits better than a solar flare, because most flares from the sun would not be powerful enough to create such a spike. Plus, they argue, a super-strong solar flare would likely have created extra-special aurora displays, which were not seen, according to historical records.

However, astrophysicists Adrian Melott of the University of Kansas and Brian Thomas of Washburn University say a flare would have to have been only about 10 or 20 times more powerful than the greatest flare on record, the so-called Carrington event of 1859. Since the records don't go back very far, such an occurrence is not out of the realm of possibility, they say.

To distinguish between the different interpretations, historians will have to look for further hints in the historical records. Neuhauser and Hambaryan also suggest looking for the object that might have resulted from the merger that caused the gamma-ray burst, which would be a 1,200-year-old black hole or neutron star that lies between 3,000 to 12,000 light-years away, but lacks the characteristic gas and dust clouds of a supernova remnant.

(Continued from page 1)
NASA'S HUBBLE REVEALS ROGUE PLANETARY ORBIT FOR FOMALHAUT B

Newly released NASA Hubble Space Telescope images of a vast debris disk encircling the nearby star Fomalhaut and a mysterious planet circling it may provide forensic evidence of a titanic planetary disruption in the system. Astronomers are surprised to find the debris belt is wider than previously known, spanning a section of space from 14 to nearly 20 billion miles from the star. Even more surprisingly, the latest Hubble images have allowed a team of astronomers to calculate the planet follows an unusual elliptical orbit that carries it on a potentially destructive path through the vast dust ring. The planet, called Fomalhaut b, swings as close to its star as 4.6 billion miles, and the outermost point of its orbit is 27 billion miles away from the star. The orbit was recalculated from the newest Hubble observation made last year.

“We are shocked. This is not what we expected,” said Paul Kalas of the University of California at Berkeley and the SETI Institute in Mountain View, Calif. The Fomalhaut team led by Kalas considers this circumstantial evidence there may be other planet-like bodies in the system that gravitationally disturbed Fomalhaut b to place it in such a highly eccentric orbit. The team presented its finding Tuesday at the 221st meeting of the American Astronomical Society in Long Beach, Calif. Among several scenarios to explain Fomalhaut b’s 2,000-year-long orbit is the hypothesis that an as yet undiscovered planet gravitationally ejected Fomalhaut b from a position closer to the star, and sent it flying in an orbit that extends beyond the dust belt.

“Hot Jupiters get tossed through scattering events, where one planet goes in and one gets thrown out,” said co-investigator Mark Clampin of NASA’s Goddard Space Flight Center in Greenbelt, Md. “This could be the planet that gets thrown out.”

Hubble also found the dust and ice belt encircling the star Fomalhaut has an apparent gap slicing across the belt. This might have been carved by another undetected planet. Hubble’s exquisite view of the dust belt shows irregularities that strongly motivate a search for other planets in the system. If its orbit lies in the same plane with the dust belt, then Fomalhaut b will intersect the belt around 2032 on the outbound leg of its orbit. During the crossing, icy and rocky debris in the belt could crash into the planet’s atmosphere and create the type of cosmic fireworks seen when Comet Shoemaker-Levy 9 crashed into Jupiter. Most of the fireworks from collisions will be seen in infrared light. However, if Fomalhaut b is not co-planar with the belt, the only thing to be seen will be a gradual dimming of Fomalhaut b as it travels farther from the star.

Kalas hypothesized that Fomalhaut b’s extreme orbit is a major clue in explaining why the planet is unusually bright in visible light, but very dim in infrared light. It is possible the planet’s optical brightness originates from a ring or shroud of dust around the planet, which reflects starlight. The dust would be rapidly produced by satellites orbiting the planet, which would suffer extreme erosion by impacts and gravitational stirring when Fomalhaut b enters into the planetary system after a millennium of deep freeze beyond the main belt. An analogy can be found by looking at Saturn, which has a tenuous, but very large dust ring produced when meteoroids hit the outer moon Phoebe.

The team has also considered a different scenario where a hypothetical second dwarf planet suffered a catastrophic collision with Fomalhaut b. The collision scenario would explain why the star Fomalhaut has a narrow outer belt linked to an extreme planet. But in this case the belt is young, less than 10,000 years old, and it is difficult to produce energetic collisions far from the star in such young systems. Fomalhaut is a special system because it looks like scientists may have a snapshot of what our solar system was doing 4 billion years ago. The planetary architecture is being redrawn, the comet belts are evolving, and planets may be gaining and losing their moons. Astronomers will continue monitoring Fomalhaut b for decades to come because they may have a chance to observe a planet entering an icy debris belt that is like the Kuiper Belt at the fringe of our own solar system.
The Art of Space Imagery
By Diane K. Fisher

When you see spectacular space images taken in infrared light by the Spitzer Space Telescope and other non-visible-light telescopes, you may wonder where those beautiful colors came from? After all, if the telescopes were recording infrared or ultraviolet light, we wouldn’t see anything at all. So are the images “colorized” or “false colored”?

No, not really. The colors are translated. Just as a foreign language can be translated into our native language, an image made with light that falls outside the range of our seeing can be “translated” into colors we can see. Scientists process these images so they can not only see them, but they can also tease out all sorts of information the light can reveal. For example, wisely done color translation can reveal relative temperatures of stars, dust, and gas in the images, and show fine structural details of galaxies and nebulae.

Spitzer’s Infrared Array Camera (IRAC), for example, is a four-channel camera, meaning that it has four different detector arrays, each measuring light at one particular wavelength. Each image from each detector array resembles a grayscale image, because the entire detector array is responding to only one wavelength of light. However, the relative brightness will vary across the array.

So, starting with one detector array, the first step is to determine what is the brightest thing and the darkest thing in the image. Software is used to pick out this dynamic range and to re-compute the value of each pixel. This process produces a grey-scale image. At the end of this process, for Spitzer, we will have four grayscale images, one for each of the four IRAC detectors.

Matter of different temperatures emit different wavelengths of light. A cool object emits longer wavelengths (lower energies) of light than a warmer object. So, for each scene, we will see four grayscale images, each of them different.

Normally, the three primary colors are assigned to these gray-scale images based on the order they appear in the spectrum, with blue assigned to the shortest wavelength, and red to the longest. In the case of Spitzer, with four wavelengths to represent, a secondary color is chosen, such as yellow. So images that combine all four of the IRAC’s infrared detectors are remapped into red, yellow, green, and blue wavelengths in the visible part of the spectrum.

Download a new Spitzer poster of the center of the Milky Way. On the back is a more complete and colorfully-illustrated explanation of the “art of space imagery.” Go to spaceplace.nasa.gov/posters/#milky-way.

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

INTO DEEPEST SPACE
The Birth of the ALMA Observatory

FRIDAY FEB. 15, 2013
7:30 PM
2001 Malott Hall
University of Kansas
FREE AND OPEN TO THE PUBLIC
Speaking of Space Imagery: Cool Andromeda

In this new view of the Andromeda galaxy from the Herschel space observatory, cool lanes of forming stars are revealed in the finest detail yet. Herschel is a European Space Agency mission with important NASA participation.

Andromeda, also known as M31, is the nearest major galaxy to our own Milky Way at a distance of 2.5 million light-years, making it an ideal natural laboratory to study star formation and galaxy evolution. Sensitive to the far-infrared light from cool dust mixed in with the gas, Herschel seeks out clouds of gas where stars are born. The new image reveals some of the very coldest dust in the galaxy - only a few tens of degrees above absolute zero - colored red in this image. By comparison, warmer regions such as the densely populated central bulge, home to older stars, take on a blue appearance. Intricate structure is present throughout the 200,000-light-year-wide galaxy with star-formation zones organized in spiral arms and at least five concentric rings, interspersed with dark gaps where star formation is absent.

Andromeda is host to several hundred billion stars. This new image of it clearly shows that many more stars will soon to spark into existence.
Astronomers have discovered what appears to be a large asteroid belt around the star Vega, the second brightest star in northern night skies. The scientists used data from NASA’s Spitzer Space Telescope and the European Space Agency’s Herschel Space Observatory, in which NASA plays an important role. The discovery of an asteroid belt-like band of debris around Vega makes the star similar to another observed star called Fomalhaut (see pg. 3). The data are consistent with both stars having inner, warm belts and outer, cool belts separated by a gap. This architecture is similar to the asteroid and Kuiper belts in our own solar system.

What is maintaining the gap between the warm and cool belts around Vega and Fomalhaut? The results strongly suggest the answer is multiple planets. Our solar system’s asteroid belt, which lies between Mars and Jupiter, is maintained by the gravity of the terrestrial planets and the giant planets, and the outer Kuiper belt is sculpted by the giant planets.

"Our findings echo recent results showing multiple-planet systems are common beyond our sun," said Kate Su, an astronomer at the Steward Observatory at the University of Arizona, Tucson. Su presented the results Tuesday at the American Astronomical Society meeting in Long Beach, Calif., and is lead author of a paper on the findings accepted for publication in the Astrophysical Journal.

Vega and Fomalhaut are similar in other ways. Both are about twice the mass of our sun and burn a hotter, bluer color in visible light. Both stars are relatively nearby, at about 25 light-years away. The stars are thought to be around 400 million years old, but Vega could be closer to its 600 millionth birthday. Fomalhaut has a single candidate planet orbiting it, Fomalhaut b, which orbits at the inner edge of its cometary belt.

The Herschel and Spitzer telescopes detected infrared light emitted by warm and cold dust in discrete bands around Vega and Fomalhaut, discovering the new asteroid belt around Vega and confirming the existence of the other belts around both stars. Comets and the collisions of rocky chunks replenish the dust in these bands. The inner belts in these systems cannot be seen in visible light because the glare of their stars outshines them.

Both the inner and outer belts contain far more material than our own asteroid and Kuiper belts. The reason is twofold: the star systems are far younger than our own, which has had hundreds of millions more years to clean house, and the systems likely formed from an initially more massive cloud of gas and dust than our solar system.

The gap between the inner and outer debris belts for Vega and Fomalhaut also proportionally corresponds to the distance between our sun’s asteroid and Kuiper belts. This distance works out to a ratio of about 1:10, with the outer belt 10 times farther from its host star than the inner belt. As for the large gap between the two belts, it is likely there are several undetected planets, Jupiter-size or smaller, creating a dust-free zone between the two belts. A good comparison star system is HR 8799, which has four known planets that sweep up the space between two similar disks of debris.

"Overall, the large gap between the warm and the cold belts is a signpost that points to multiple planets likely orbiting around Vega and Fomalhaut," said Su. If unseen planets do, in fact, orbit Vega and Fomalhaut, these bodies will not likely stay hidden. "Upcoming new facilities such as NASA’s James Webb Space Telescope should be able to find the planets," said paper co-author Karl Stapelfeldt, chief of the Exoplanets and Stellar Astrophysics Laboratory at NASA’s Goddard Space Flight Center in Greenbelt, Md.
Space Instrument Adds Big Piece to Solar Corona Puzzle

The Sun's visible surface, or photosphere, is 10,000 degrees Fahrenheit. As you move outward from it, you pass through a tenuous layer of hot, ionized gas or plasma called the corona. The corona is familiar to anyone who has seen a total solar eclipse, since it glimmers ghostly white around the hidden Sun.

But how can the solar atmosphere get hotter, rather than colder, the farther you go from the Sun's surface? This mystery has puzzled solar astronomers for decades. A suborbital rocket mission that launched in July 2012 has just provided a major piece of the puzzle.

The High-resolution Coronal Imager, or Hi-C, revealed one of the mechanisms that pumps energy into the corona, heating it to temperatures up to 7 million degrees F. The secret is a complex process known as magnetic reconnection.

"This is the first time we've had images at high enough resolution to directly observe magnetic reconnection," explained Smithsonian astronomer Leon Golub (Harvard-Smithsonian Center for Astrophysics). "We can see details in the corona five times finer than any other instrument."

"Our team developed an exceptional instrument capable of revolutionary image resolution of the solar atmosphere. Due to the level of activity, we were able to clearly focus on an active sunspot, thereby obtaining some remarkable images," said heliophysicist Jonathan Cirtain (Marshall Space Flight Center).

Magnetic braids and loops

The Sun's activity, including solar flares and plasma eruptions, is powered by magnetic fields. Most people are familiar with the simple bar magnet, and how you can sprinkle iron filings around one to see its field looping from one end to the other. The Sun is much more complicated.

The Sun's surface is like a collection of thousand-mile-long magnets scattered around after bubbling up from inside the Sun. Magnetic fields poke out of one spot and loop around to another spot. Plasma flows along those fields, outlining them with glowing threads.

The images from Hi-C showed interweaved magnetic fields that were braided just like hair. When those braids relax and straighten, they release energy. Hi-C witnessed one such event during its flight.

It also detected an area where magnetic field lines crossed in an X, then straightened out as the fields reconnected. Minutes later, that spot erupted with a mini solar flare.

Hi-C showed that the Sun is dynamic, with magnetic fields constantly warping, twisting, and colliding in bursts of energy. Added together, those energy bursts can boost the temperature of the corona to 7 million degrees Fahrenheit when the Sun is particularly active.

(Continued on page 10)
DEM L50 is a so-called superbubble found in the Large Magellanic Cloud. Superbubbles are created by winds from massive stars and the shock waves produced when the stars explode as supernovas. This composite of DEM L50 features X-rays from Chandra (pink) and optical data (red, green, and blue). This composite image shows the superbubble DEM L50 (a.k.a. N186) located in the Large Magellanic Cloud about 160,000 light years from Earth. Superbubbles are found in regions where massive stars have formed in the last few million years. The massive stars produce intense radiation, expel matter at high speeds, and race through their evolution to explode as supernovas. The winds and supernova shock waves carve out huge cavities called superbubbles in the surrounding gas.

X-rays from NASA's Chandra X-ray Observatory are shown in pink and optical data from the Magellanic Cloud Emission Line Survey (MCELS) are colored in red, green and blue. The MCELS data were obtained with the University of Michigan's 0.9-meter Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory (CTIO). The shape of DEM L50 is approximately an ellipse, with a supernova remnant named SNR N186 D located on its northern edge. Like another superbubble in the LMC, N44, DEM L50 gives off about 20 times more X-rays than expected from standard models for the evolution of superbubbles. A Chandra study published in 2011 showed that there are two extra sources of the bright X-ray emission: supernova shock waves striking the walls of the cavities, and hot material evaporating from the cavity walls. The Chandra study of DEM L50 was led by Anne Jaskot from the University of Michigan in Ann Arbor. The co-authors were Dave Strickland from Johns Hopkins University in Baltimore, MD, Sally Oey from University of Michigan, You-Hua Chu from University of Illinois and Guillermo Garcia-Segura from Instituto de Astronomia-UNAM in Ensenada, Mexico.
Selecting the target

The telescope aboard Hi-C provided a resolution of 0.2 arcseconds -- about the size of a dime seen from 10 miles away. That allowed astronomers to tease out details just 100 miles in size. (For comparison, the Sun is 865,000 miles in diameter.)

Hi-C photographed the Sun in ultraviolet light at a wavelength of 19.3 nanometers -- 25 times shorter than wavelengths of visible light. That wavelength is blocked by Earth's atmosphere, so to observe it astronomers had to get above the atmosphere. The rocket's suborbital flight allowed Hi-C to collect data for just over 5 minutes before returning to Earth.

Hi-C could only view a portion of the Sun, so the team had to point it carefully. And since the Sun changes hourly, they had to select their target at the last minute -- the day of the launch. They chose a region that promised to be particularly active.

"We looked at one of the largest and most complicated active regions I've ever seen on the Sun," said Golub. "We hoped that we would see something really new, and we weren't disappointed."

Next steps

Golub said that data from Hi-C continues to be analyzed for more insights. Researchers are hunting areas where other energy release processes were occurring.

In the future, the scientists hope to launch a satellite that could observe the Sun continuously at the same level of sharp detail.

"We learned so much in just five minutes. Imagine what we could learn by watching the Sun 24/7 with this telescope," said Golub.