The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 34 Number 05 **May 2008**

Calendar of Events

ASTRONOMY DAY

SATURDAY, MAY 10

Day Time Events

Lawrence Public Library

1:00 — 4:00 PM

Evening Events

Night-Sky Observing

Weather Permitting

Prairie Park Nature Center

9:00 — 11:00 PM

President:
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INSIDE THIS ISSUE

Report from the Officers:

We had a nice turnout for our last meeting, in part due to the need to plan for ASTRONOMY DAY. The IMAX DVD presentation, DESTINY IN SPACE, narrated by Leonard Nimoy, was, as always, graphically spectacular, but a little dated. It dealt with the development and deployment of a variety of space-based missions of the 80's and early 90's, culminating in the initial launch of the Hubble Space Telescope and the mission to repair the mirror a couple of years later. It was exciting to see astronaut Steve Hawley, who led the mission to launch the HST and will begin his career at KU in Fall 2008. As stated above, more important for this meeting was the planning for Astronomy Day, set for Saturday, May 10. As the enclosed poster details, 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

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Flaring Temper Causes Sun to Quake

By Jeanna Bryner

Mighty eruptions on the sun trigger bursts of sound waves that ripple across the fiery ball of gas, astronomers say.

The finding, which will be published in the May 1 issue of the *Astrophysical Journal Letters*, comes from data collected with the Solar and Heliospheric Observatory (SOHO), a joint venture between NASA and ESA.

Astronomers have known that sound waves constantly trek toward the sun's interior, producing a background "ringing" of sorts. As they move through the sun's plasma, the sound waves take on a pulsing pattern of five minutes, and hence are called five-minute oscillations. They are also called starquakes.

"We see the plasma moving toward us, receding from us, moving toward us, receding from us," said Bernhard Fleck, SOHO project scientist at NASA Goddard Space Flight Center in Greenbelt, Md. "It's like waves in the ocean."

Until now, scientists thought the oscillations were caused by churning gas near the interior of the sun. And the churning gas does play a role, but there's more.

These global oscillations can be thought of as the sound you would get from a bell sitting in the middle of the desert that is constantly tapped by random sand grains.

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From the Officers, continued

(Continued from page 1)

displays and DVD 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 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 interest in helping with the event that day. For the evening, we have arranged to use the Prairie Park Nature Center for the site of the observing, as usual, weather permitting. We have a number of telescopes available for use that night, including one with a video display constructed by Dave Kolb that allows integrations up to 8 seconds long, making it possible for people to see faint objects like galaxies and nebulae without the need to strain their sight looking through the eyepiece. If the Prairie Park site is successful, it could become a regular stop for AAL Star Parties in the future since the people in charge of the park would love to expand the number of visitors to the site. If you can help or contribute to the event, please contact Rick Heschmeyer.

A major breakthrough—our bad luck with the weather finally broke for the final observing session of the semester at the football stadium! The clouds that were around all day long finally cleared away on Sunday evening and we were able to set up a handful of scopes, including a successful session by the Edwards, using their newly acquired Celestron for one of the first times this year. The one down side to the evening was the temperature. Despite being the last week in April, the temperatures closed in on the 30's by the end of the night and gradually encouraged us to pack up as quickly as possible, once the endpoint of 10:30 PM approached. Hopefully, this problem won't repeat for the May 10 observing next week!

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 Astronomy Day on the 10th. As we enter our summer schedule, we will attempt to set up some post-band-concert observing sessions downtown. ALL for now.

(Continued from page 1)

Now Christoffer Karoff and Hans Kjeldsen, both at the University of Aarhus, Denmark, find that every once in a while somebody bangs a hammer on the bell — bing — causing a stint of intense sound waves. That hammer, they found, comes from powerful solar flares.

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

They discovered a strong correlation between an increase in the number of solar flares and a bump in the strength of the five-minute oscillations.

"This large flare on the sun, this disturbance, shakes the sun and then it keeps vibrating for some time with these global oscillations," says Fleck.

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

Now the researchers hope to figure out more about exactly how the flares cause the oscillations.

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

Milky Ways Giant Black Hole Awoke From Slumber 300 Years Ago

NASA Press Release

Using NASA, Japanese, and European X-ray satellites, a team of Japanese astronomers 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 Ways black hole so quiescent? The black hole, known as Sagittarius A* (pronounced "A-star"), is a certified monster, containing about 4 million times the mass of our Sun. Yet the energy radiated from its surroundings is billions of times weaker than the radiation emitted from central black holes in other galaxies.

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

The new study, which will appear in the Publications of the Astronomical Society of Japan,combines results from Japans Suzaku and ASCA X-ray satellites, NASAs Chandra X-ray Observatory, and the European Space Agencys XMM-Newton X-ray Observatory. 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 and more matter piles up near the black hole, the greater the X- ray output.

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, Suzakus 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 holes 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 Pasadena, Calif., 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 center 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. Launched in 2005, Suzaku is the fifth in a series of Japanese satellites devoted to studying celestial X-ray sources and is managed by the Japan Aerospace Exploration Agency (JAXA). This mission is a collaborative effort between Japanese universities and institutions and NASA Goddard.

Black Hole Found in Center of Star Cluster Omega Centauri

The astronomers say the black hole suggests Omega Centauri is a dwarf galaxy, not a globular cluster. First identified as a single star nearly 2,000 years ago, Omega Centauri was later reclassified as a nebula, and more recently as a globular cluster. It's visible to the unaided eye to those in the southern hemisphere.

The discovery was led by Eva Noyola of the Max-Planck Institute for Extraterrestrial Physics in Garching, Germany, using images taken by the Hubble Space Telescope, in addition to spectrographic data from the Gemini South telescope in Chile.

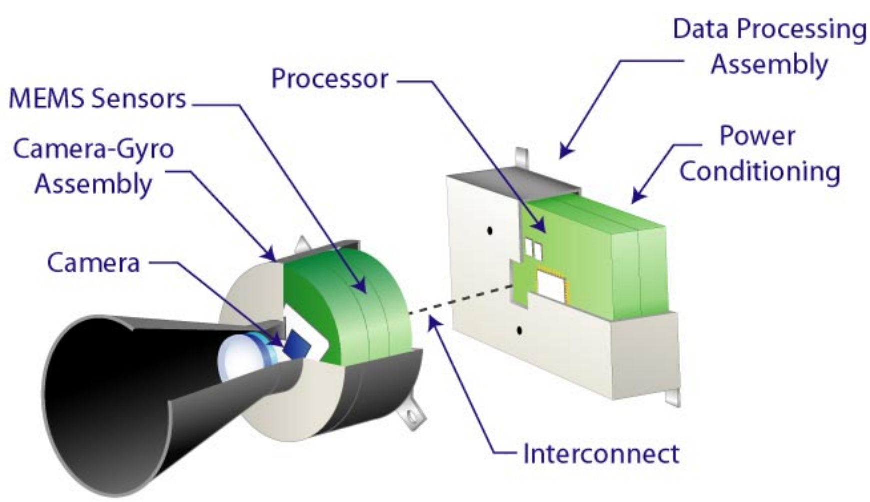
Noyola and her colleagues, including astronomer Karl Gebhardt of the University of Texas at Austin, found the high velocities of stars in the cluster's center could be accounted for only by the presence of an invisible object in the center of the cluster with a mass 40,000 times that of the Earth's sun.

Stellar Compass for Space Explorers

by Patrick L. Barry

In space, there's no up or down, north or south, east or west. So how can robotic spacecraft know which way they're facing when they fire their thrusters, or when they try to beam scientific data back to Earth?

Without the familiar compass points of Earth's magnetic poles, spacecraft use stars and gyros to know their orientation. Thanks to a recently completed test flight, future spacecraft will be able to do so using only an ultra-low-power camera and three silicon wafers as small as your pinky fingernail.



Compass is built as two separate assemblies, the camera-gyro assembly and the data processor assembly, connected by a wiring harness. The technology uses an active pixel sensor in a wide-field-of-view miniature star camera and micro-electromechanical system (MEMS) gyros. Together, they provide extremely accurate information for navigation and control.

"The wafers are actually very tiny gyros," explains Artur Chmielewski, project manager at JPL for Space Technology 6 (ST6), a part of NASA's New Millennium Program.

Traditional gyros use spinning wheels to detect changes in pitch, yaw, and roll—the three axes of rotation. For ST6's Inertial Stellar Compass, the three gyros instead consist of silicon wafers that resemble microchips. Rotating the wafers distorts microscopic structures on the surfaces of these wafers in a way that generates electric signals. The compass uses these signals—along with images of star positions taken by the camera—to measure rotation.

Because the Inertial Stellar Compass (ISC) is based on this new, radically different technology, NASA needed to flight-test it before using it in important missions. That test flight reached completion in December 2007 after about a year in orbit aboard the Air Force's TacSat-2 satellite.

"It just performed beautifully," Chmielewski says. "The data checked out really well." The engineers had hoped that ISC would measure the spacecraft's rotation with an accuracy of 0.1 degrees. In the flight tests, ISC surpassed this goal, measuring rotation to within about 0.05 degrees.

That success paves the way for using ISC to reduce the cost of future science missions. When launching probes into space, weight equals money. "If you're paying a million dollars per kilogram to send your spacecraft to Mars, you care a lot about weight," Chmielewski says. At less than 3 kilograms, ISC weighs about one-fifth as much as traditional stellar compasses. It also uses about one-tenth as much power, so a spacecraft would be able to use smaller, lighter solar panels.

Engineers at Draper Laboratory, the Cambridge, Massachusetts, company that built the ISC, are already at work on a next-generation design that will improve the compass's accuracy ten-fold, Chmielewski says. So ISC and its successors could soon help costs—and spacecraft—stay on target.

Find out more about the ISC at nmp.nasa.gov/st6. Kids can do a fun project and get an introduction to navigating by the stars at spaceplace.nasa.gov/en/kids/st6starfinder/st6starfinder.shtml.

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

National ASTRONOMY DAY 2008

SATURDAY, MAY 10

Daytime Events:

1:00 - 4:00 PM

Lawrence Public Library

SOLAR OBSERVING

DVD PRESENTATIONS

AMATEUR ASTRONOMY

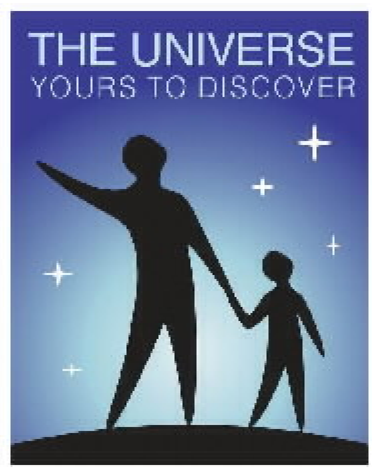
Evening Events:

9:00 - 11:00 PM

Prairie Park

Nature Center

2730 Harper



STAR PARTY - NIGHT SKY OBSERVING

(Weather Permitting)

FREE AND OPEN TO THE PUBLIC

Ultra-dense Galaxies Found In Early Universe

Science Daily

A team of astronomers looking at the universe's distant past found nine young, unusually compact galaxies, each weighing in at 200 billion times the mass of the Sun. These young galaxies are the equivalent of a human baby that is 20 inches long, yet weighs 180 pounds.

"Seeing the compact sizes of these galaxies is a puzzle," said Pieter G. van Dokkum of Yale, who led the study. "No massive galaxy at this distance has ever been observed to be so compact, and it is not yet clear how one of these would build itself up to be the size of the galaxies we see today." The findings appeared in the April 10 issue of The Astrophysical Journal Letters.

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 could fit inside the central hub of the Milky Way. "These ultra-dense galaxies, forming the building blocks of today's largest galaxies, might comprise half of all galaxies of that mass at this early time," van Dokkum said.

But, van Dokkum noted that they would have to change a lot over 11 billion years -- they would have to grow five times bigger, "While they could get larger by colliding with other galaxies, such collisions may not be the complete answer," he said.

Astronomers used NASA's Hubble Space Telescope and the W.M. Keck Observatory on Mauna Kea, Hawaii, to study the galaxies whose light has been traveling toward us for 11 billion years. "What we see now is the way these compact galaxies existed 11 billion years ago, when the universe was less than 3 billion years old," van Dokkum explained. "Only Hubble and Keck can see the sizes of these galaxies because they are very small and far away."

In 2006, the research team also studied the galaxies 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, and that 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."

Van Dokkum speculated on how these small, crowded galaxies formed. He said, one way could have involved an interaction in the emerging universe between hydrogen gas and dark matter -- 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. He said that hydrogen gas could have been trapped in puddles of the invisible material which began spinning rapidly in dark matter's gravitational whirlpool, forming stars at a furious rate.

The astronomers estimated that the stars in the compact galaxies are spinning around their galactic disks at roughly 1 million miles an hour (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.

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. The team says that the new images should lead to a better understanding of the evolution of galaxies early in the life of the universe.

NASA Satellite Pins Down Timer In Stellar Ticking Time Bomb

Using NASA's Rossi X-ray Timing Explorer (RXTE) satellite, a team of four astronomers has discovered a timing mechanism that tells them exactly when a superdense star will let loose incredibly powerful explosions.

"We found a clock that ticks slower and slower, and when it slows down too much, boom! The bomb explodes," says team leader Diego Altamirano of the University of Amsterdam in the Netherlands.

The explosions occur on a neutron star, which is a city-sized remnant of a giant star that exploded in a supernova. But despite the neutron star's small size, it contains more material than our sun. The neutron star is not alone in space. It has a companion star, and the two objects orbit each other every 3.8 hours. This double-star system is known as 4U 1636-53 for its sky coordinates in the Southern Hemisphere.

The system acts like a ticking time bomb. The neutron star has incredibly strong gravity, so it sucks in some of the gas from the companion star's atmosphere. The gas spirals onto the neutron star, slowly building up on its surface until it heats up to a critical temperature. Suddenly, the gas at one small spot on the neutron star's surface ignites a powerful explosion, and the flame quickly spreads around the entire star. The resulting explosion appears as a bright flash of X-rays that can be detected by satellites.

The neutron star in 4U 1636-53 produces about 7 to 10 bursts per day. These explosions are mind-boggling to contemplate. They release more energy in just 10 to 100 seconds than our sun radiates in an entire week. The energy is equivalent to 100 hydrogen bombs exploding simultaneously over each postage-stamp-size patch of the neutron star's surface. It's a good thing for us that this neutron star is 20,000 light-years from Earth, which is far enough away that the explosions pose no danger to humans or our planet. Fortunately for the neutron star, the explosion takes place only on its surface and in its atmosphere, so the neutron star survives the blast.

Scientists have observed thousands of similar X-ray bursts from about 80 different neutron stars. But until now, they had no way to predict when they would occur.

The key to this discovery is RXTE, which makes extremely precise timing measurements of objects that emit X-rays in a rapidly flickering pattern. As gas gradually builds up on the neutron star's surface, the atoms that make up the gas slam together to form heavier atoms in a process known as fusion. Sometimes, the fusion occurs in a stable and almost perfectly repetitive fashion, producing a nearly regular X-ray signal known as a quasi-periodic oscillation (or QPO for short). Think of the QPO as a clock that ticks with near-perfect precision.

Scientists expect that the QPO clock should tick about once every two minutes (120 seconds). This is what Altamirano's team found when the astronomers observed the system with RXTE. But the team also found that the QPO clock starts ticking slower and slower as gas builds up on its surface. Whenever it slows down to one cycle every 125 seconds, the neutron star lets loose a powerful explosion.

"We can predict when these explosions are happening. We have a clock that tells us when the bomb will explode!" says Altamirano.

"It's an exciting discovery," adds Tod Strohmayer of NASA's Goddard Space Flight Center in Greenbelt, Md. Strohmayer is an expert in neutron stars who was not involved in this study. He notes that the ticking of the QPO clock depends on the size and weight of the neutron star. "It gives us a new tool to study these fascinating objects," he says.

Adapted from materials provided by NASA/Goddard Space Flight Center.

Home of Drifting Star Found

By Andrea Thompson, Space.com

By listening to the "ringing" of a nearby planet-harboring star, astronomers have for the first time identified the birthplace of one of our galaxy's many drifting stars. The yellow-orange star Iota Horologii, located 56 light-years away near the southern-sky constellation Horologium ("The Clock"), was discovered to harbor a planet about two times the size of Jupiter in 1999.

But until now, scientists were unable to identify the exact characteristics of the star, or where in the galaxy it had formed. The star currently resides in the "Hyades Stream," a large number of stars that move in the same direction, many of which are thought to be so-called "drifting stars" — stars that were displaced from their birthplace. The new method used by the team of astronomers to identify Iota Horologii's stellar parentage involves studying how sound waves move through a star.

The approach could be used to ID other orphaned stars — estimated to make up about 20 percent of the stars within 1,000 light-years of the sun — and shed more light on how these stars move in the galaxy.

Good vibrations

Sylvie Vauclair of the University of Toulouse in France and her team of astronomers used a technique called "asteroseismology" to unlock the elusive properties of the star.

"In the same way as geologists monitor how seismic waves generated by earthquakes propagate through the Earth and learn about the inner structure of our planet, it is possible to study sound waves running through a star," Vauclair explained. This "ringing" of the star gives scientists information about the physical conditions in the star's interior. With observations taken from the HARPS spectrograph, which is mounted on the European Southern Observatory's 3.6-meter telescope at La Silla, Chile, up to 25 "notes" were identified by the team.

"You can analyze the sound and analyze the harmonies, and you can get the harmonies of the star," Vauclair said. "And different stars have different harmonies."

These notes gave the astronomers a precise portrait of the star: its temperature is 6,150 Kelvin, its mass is 1.25 times that of the Sun, and it is 625 million years old. It is also 1.5 times as metal-rich as the sun, which was the clue astronomers needed to figure out where the star came from — the Hyades cluster.

"Iota Horologii has the same metal abundance and age as the Hyades cluster," Vauclair said, adding that "the chance is really low that it's a coincidence."

The team's findings are detailed in a Letter to the Editor in the journal *Astronomy and Astrophysics*.

Other stellar drifters inhabit these so-called "streams" that travel with the same velocity as nearby clusters, with some of them suspected to have formed in the cluster. In the Hyades stream, previous research has shown that "most of the stars have not been formed in the Hyades," Vauclair said. Only about 15 percent were estimated to come from the Hyades cluster.

"This guy [Iota Horologii] would be one of this 15 percent," Vauclair told *SPACE.com*. "I think it's the first star for which we have this result."

Vauclair says the star must have formed together with the other stars of the Hyades cluster, but then must have slowly drifted away, to its current spot more than 130 light-years from its birthplace. Previous research has shown that quite a few stars follow unusual trajectorie compared to most stars, which orbit the Milky Way's center. It is thought that the wanderers may be gravitationally stirred by the spiral arms of the galaxy, which could deflect the motions of the stars. The stars may eventually get sucked into other arrangements of stars with more normal paths around the galactic center, which is thought to have happened to most of the stars in the Hyades stream, Vauclair said.

Plenty of other clusters have associated streams, and the same method that Vauclair and her team used to ID Iota Horologii could be used to pinpoint where other stars came from, shedding light on how they got to where they are now, she said.

Secrets Of Massive Black Hole Unveiled: Workings Of Giant Galactic Particle Accelerators Discovered

At the cores of many galaxies, supermassive black holes expel powerful jets of particles at nearly the speed of light. Just how they perform this feat has long been one of the mysteries of astrophysics. The leading theory says the particles are accelerated by tightly-twisted magnetic fields close to the black hole, but confirming that idea required an elusive close-up view of the jet's inner throat. Now, 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 and behaving exactly as predicted by the theory.

"We have gotten the clearest look yet at the innermost portion of the jet, where the particles actually are accelerated, and everything we see supports the idea that twisted, coiled magnetic fields are propelling the material outward," said Alan Marscher, of Boston University, leader of an international research team. "This is a major advance in our understanding of a remarkable process that occurs throughout the Universe," he added.

Marscher's team studied a galaxy called BL Lacertae (BL Lac), some 950 million light-years from Earth. BL Lac is a blazar, the most energetic type of black-hole-powered galactic core. A black hole is a concentration of mass so dense that not even light can escape its gravitational pull. Supermassive black holes in galaxies' cores power jets of particles and intense radiation in similar objects including quasars and Seyfert galaxies. Material pulled inward toward the black hole forms a flattened, rotating disk, called an accretion disk. As the material moves from the outer edge of the disk inward, magnetic field lines perpendicular to the disk are twisted, forming a tightly-coiled bundle that, astronomers believe, propels and confines the ejected particles. Closer to the black hole, space itself, including the magnetic fields, is twisted by the strong gravitational pull and rotation of the black hole.

Theorists predicted that material moving outward in this close-in acceleration region would follow a corkscrew-shaped path inside the bundle of twisted magnetic fields. They also predicted that light and other radiation emitted by the moving material would brighten when its rotating path was aimed most directly toward Earth.

Marscher and his colleagues predicted there would also be a flare later when the material hits a stationary shock wave called the "core" some time after it has emerged from the acceleration region.

"That behavior is exactly what we saw," Marscher said, when his team followed an outburst from BL Lac. In late 2005 and early 2006, the astronomers watched BL Lac with an international collection of telescopes as a knot of material was ejected outward through the jet. As the material sped out from the neighborhood of the black hole, the VLBA could pinpoint its location, while other telescopes measured the properties of the radiation emitted from the knot. Bright bursts of light, X-rays, and gamma rays came when the knot was precisely at locations where the theories said such bursts would be seen. In addition, the alignment of the radio and light waves -- a property called polarization -- rotated as the knot wound its corkscrew path inside the tight throat of twisted magnetic fields.

"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," Marscher said.

In addition to the continent-wide VLBA, an array of 10 radio telescopes spread from Hawaii to the Virgin Islands, the team used telescopes at the Steward Observatory, the Crimean Astrophysical Observatory, Lowell Observatory, Perugia University Astronomical Observatory, Abastumani Astrophysical Observatory, NASA's Rossi X-Ray Timing Explorer, the University of Michigan Radio Astronomy Observatory, and the Metsahovi Radio Observatory. The astronomers reported their findings in the April 24 issue of the journal Nature.

The National Radio Astronomy Observatory is a facility of the National Science Foundation, operated under cooperative agreement by Associated Universities, Inc.

Adapted from a press release from the National Radio Astronomy Observatory.

Celestial Mechanic May 2008

AAL

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