may 2008

canopus

monthly newsletter of the johannesburg centre of assa

Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg
PO Box 412 323, Craighall, 2024

NGC 2070 – The Tarantula Nebula in Dorado. Photo by Bert van Winsen

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notice of next meeting – assa johannesburg

The next monthly meeting of the Johannesburg Centre of the Astronomical Society of Southern Africa will be held at the Old Republic Observatory, 18a Gill Street, Observatory, Johannesburg on Wednesday, 14 May 2008 at 20h00. . Guest Speaker:

Bob Argyle

"The Webb Society - its history and double star activities"

assa johannesburg calendar

Date	Event	Details
10 May	Committee Meeting	War Museum @ 14:00
14 May	Monthly Meeting	Observatory @ 20:00 – Bob Argyle
17 May	SAASTA Public Viewing Evening	Observatory @ 19:00 – Bob Argyle & Brian Fraser
24 May	ScopeX 2008	War museum @ 09:00
07 June	Committee Meeting	War museum @ 14:00
11 June	Monthly Meeting	Observatory @ 20:00 - Gary Els

assa johannesburg committee members 2007/2008

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The ASSA Johannesburg Centre is delighted to host the ASSA (National) AGM on Saturday 26 July at 4pm at the Johannesburg Observatory.

After the AGM formal proceedings there will be refreshments and viewing through the Innes Telescope.

editorial

by Claire A. Lee

Particle physics is fun, for the casual observer at least. I'm not saying that if you decide to pursue a career in particle physics you are not allowed to enjoy the field, but it's rather hard to imagine that what really gets a particle physicist excited are the pages of long equations stuffed with integrals and Greek letters that come with the territory. Well, the theorists, perhaps, but not so much for me. I enjoy the experimental aspect, the building of huge detectors to detect the smallest of particles that make up the universe, and searching diligently through mounds of data for that small signal that makes the time and money spent all worthwhile.

Last month we spoke about the LHC, set to be the world's largest particle accelerator situated at CERN on the border of France and Switzerland. This month, we'll talk about a telescope, though it's unlike any telescope you have ever come across. For one, it's buried 1.5 km below the surface in Antarctica. For another, it doesn't detect light, or radio waves, or microwaves, or any other part of the electromagnetic spectrum. It detects neutrinos.

Neutrinos, meaning "little neutral ones", are subatomic particles produced by the decay of radioactive elements and elementary particles that lack an electric charge. They were first postulated in December, 1930 by Wolfgang Pauli to explain the energy spectrum of beta decays, the decay of a neutron into a proton and an electron. Pauli theorized that an undetected particle was carrying away the observed difference between the energy and angular momentum of the initial and final particles. However, it took another 25 years before they were first detected experimentally in 1956, earning Clyde L. Cowan and Frederick Reines the 1995 (yes, that much later) Nobel Prize in Physics. Most of physics is about waiting.

Of all high-energy particles, only neutrinos can convey astronomical information from black holes and cataclysmic processes from as far away as the edge of the universe, because they only interact through the weak nuclear force and gravity, making them extremely difficult to detect since they are able to pass through ordinary matter almost undisturbed. But IceCube, a square-kilometer scale neutrino telescope buried at the South Pole, will detect them. IceCube is currently under construction (though only in the Antarctic summertime) by an international team of researchers, and due to be completed in 2010. IceCube is expanding and encompassing its prototype experiment, the Antarctic Muon And Neutrino Detector Array (AMANDA), which started detecting neutrinos at the pole since 1996. AMANDA is featured in a two-part article, "Antarctic Dreams" by Francis Halzen on page 8.

So as winter starts to worm its way into our bones, curl up with a coffee and this month's *Canopus*, and just remember that the average *summer* temperature in Antarctica is **-37°C**! ■

chairman's chat

by Robert Groess

What is it, exactly, that astronomers do? How do astronomers make a living? How can we learn so much about our universe from just looking at some pretty (and sometimes no-so-pretty) pictures and images from objects unfathomably far away? The only true messengers for us to use are faithful photons bridging the gap between the light years. Some of these questions have been answered most eloquently by Gil Jacobs in his beginner's course on astronomy, as well as the action-packed presentation he gave at the April monthly meeting. While Gil may not have expressed these questions written as above, I have no doubt the keys to answering them were dished out to those who attended.

There is a rigorous component to astronomy which dates back to the early tentative footsteps which astronomy paved in its early days, many millennia ago. And in grappling to answer some of the then seemingly perplexing observations of the heavens above, the early pioneers of astronomy had forged new methods and techniques, often deriving mathematical tools to make sense of it all. These tools do not age. They are as effective now as they were countless centuries ago. And it is some of these tools with which people left after Gil's lecture series.

Keeping the momentum going, Oleg Toumilovitch prepared a multi-media presentation on how to use a modest (and maybe not so modest) digital camera to take some of your very own images of celestial objects. Oleg also brought with some of his equipment to give a practical demonstration after his lecture. Astrophotography has been and always will be a fascinating avenue to explore. With new technology on the market, there is a plethora of ways and means with which to take astronomical images. And the only true limit to what is possible is your imagination (as well as the nasty little word "budget").

That said, Oleg made a very important point, in that while astrophotography today is essentially married to image processing techniques, there is simply no substitute to perfecting the art of getting really stunning raw images first. Image processing techniques are very powerful, but only in the right hands, and certainly do not substitute for the real thing.

For a consolidated perspective on some of the myriad aspects which astronomy is, does and caters for, make a date to visit the War Museum in Johannesburg on 24 May 2008. ScopeX 2008 covers a wide spectrum of astronomical interests for the amateur, including home-built telescope exhibitions, a range of astronomical lectures from professionals such as Professor David L. Block, an astrophotography competition, books sales, demonstrations of various kinds, and with fingers crossed, an Eskom assisted star-party from 6pm (if they stick to their load-shedding schedule!). Looking forward to seeing you there. And as always, clear skies! Robert ■

Annual Telescope & Astronomy Expo

24 May 2008 - 9am to 9pm

Military History Museum – Johannesburg

- The website has latest Event Schedule listing the talks, workshops and scheduled science shows - also the guidelines for exhibiting your ATM items and astrophotos
- Please help to advertise - on the website are flyers and a car window banner to download
- The are excellent prizes lined up to give away as awards, in the Lucky Draw and of course the Raffle for which we already have a 10 inch telescope to give away! Thank you to our commercial exhibitors and sponsors:

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- Keep watching the website for details: www.assajhb.co.za

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letter to the editor

by John Dean

I enjoyed your editorial in the April issue of Canopus about the Large Hadron Collider (LHC) and the lawsuit being brought by two people in Hawaii to prevent it from operating until a safety analysis is done of the risk of black hole production! Hawking's theory indicates these mini black holes would be very short lived and that they should evaporate into a stream of many lighter particles. (see "The CERN LHC – a Black Hole factory" by John Craven). However if the theory were wrong and stable mini black holes were to form they could present a threat to us.

You mentioned this is unlikely due to the continued presence of Earth in spite of a continuous bombardment by high energy cosmic rays, which should also be able to form these very small black holes. Another simple means of checking for the existence of stable microscopic black holes can be done astronomically. If a mini black hole were to enter a star and start accreting matter, the star would be eaten from within and might wink out of existence suddenly without forming a supernova explosion first! Whether there would be any sign of this occurring would require a theoretical study. The occurrence of such a phenomenon could easily be checked by comparing old photographic plates of a rich star field with more recent plates (or CCD images) of the same region of sky. I suspect that if there were any such events they should have been detected by now! ■

the other side of darkness

by Trevor Turton

What an upheaval load shedding has caused! To hear folk talk you would think that Moses brought electricity down from Mount Sinai, and that it has been our birthright ever since. We have had to replace our electric hob with a gas one, buy gas lights and a gas heater and lots of torches, and it is a schlep to be sure. But there are some unexpected benefits.
When the lights go out at night, no one can watch TV or cruise the Internet, and family members are finding one another again, lingering round candlelit dinner tables, playing old fashioned board and card based games, and rediscovering the joys of conversation.

For me an unexpected bonus was walking outside last night at about 9PM and seeing a wonderful sky, studded with many familiar constellations that I have never been able to see properly before from my back yard in Craighall Park, Joburg. What an unexpected treat! The Moon was up and bright, so the seeing wasn't that great, but I'm actually looking forward to our next scheduled evening load shed when the Moon will be down so that I can take out a telescope and enjoy observing stars and planets from the middle of Joburg.

Thanks, Eskom. Can we make this a permanent arrangement? ■

antarctic dreams – part 1

by Prof. Francis Halzen (http://icecube.wisc.edu/~halzen/)

Francis Halzen is a theoretician studying problems at the interface of particle physics, astrophysics and cosmology. He has been working on the AMANDA experiment since 1987. AMANDA is a telescope situated at the South Pole, built to detect neutrinos from far-off cosmic events such as gamma ray bursts and black holes. Halzen's team is currently working on a project called IceCube, the kilometre-scale successor to AMANDA. – Ed.

Big science, as often as not, hinges on small moments. Once the grants have been secured and the politics navigated, the ground broken and the visionary promises made, when banks of computers flicker to life and fingers curl above keyboards, ready to flash the first discoveries via E-mail, a decade's work can still come crashing down in the final hour—a castle erected in the thin air of theory, too weak to withstand true gravity.

Last August, when Dennis S. Peacock came to visit my office at the University of Wisconsin-Madison, he must have had something like that in the back of his mind. As the head of the Antarctic sciences section for the National Science Foundation (NSF), Peacock had helped funnel some $10 million into building the world's largest neutrino telescope deep in the Antarctic ice. Would we have anything to show for the investment? Or would our project go the way of its predecessor, partly built in seawater off the coast of Hawaii and then abandoned after nearly twenty years of work?

Our telescope—also known as the Antarctic Muon and Neutrino Detector Array, or AMANDA—had been detecting neutrinos for some time, but we had yet to finish analyzing our first data. Or so I thought. Instead, when Peacock and I arrived at the desk of my graduate student, Rellen R. Hardtke, she had a surprise waiting for me. Two of her colleagues had spent the night finishing the analysis, she explained with a smile. Then she calmly called up an image on her computer screen: the first precision map of a high-energy neutrino event ever recorded.

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Preparation for drilling holes for AMANDA's optical sensors begins with a sled bringing equipment.

Hardtke's screen showed a faint blue line streaking diagonally across columns of black dots. Most of the dots, each of which represented a photomultiplier sunk in the ice, were small and black. But a few, clustered along the line, were blue or green or red, and two, near the beginning of the line, were bright orange and very large. At five in the morning on October 12, 1997, the diagram told us, a neutrino—one of nature's smallest and most elusive elementary particles—had entered the earth in the middle of the Pacific Ocean, between Midway Island and the Aleutians, hurtled straight through the planet, and collided

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Checking the list to make sure everything is in order.

head-on with a proton on the underside of the Antarctic ice. Two kilometers beneath the surface, our grid of photomultipliers had picked up a subatomic spark from that collision as it flew upward through the ice and flared past them for about a microsecond.

The end result, abstracted on a computer screen, would have seemed unremarkable to most people. But to us it was the sole trace of a particle that had traversed vast distances to reach us, perhaps a remnant of one of the most spectacular events in the universe. More to the point, it was the first concrete proof that AMANDA worked—that it could help map the distant depths of space, thereby perhaps resolving some of the most heated controversies in physics. Later, when I E-mailed the diagram to our collaborators, one of them wrote back: "This is why I've spent five years of my life on this project."

"Neutrinos, they are very small," John Updike wrote, famously. "They have no charge and have no mass / And do not interact at all." As it turns out, Updike was wrong on two counts, but he got the spirit right, anyway. Neutrinos are so small and slippery that they pass through the Earth (and stars and cities and most everything else) like a bullet through a rainstorm. Unfazed by magnetic fields or the strong nuclear force, they have to make a direct hit on a proton to be stopped at all—a highly unlikely event. At the same time, neutrinos are about as plentiful in the universe as the photons that constitute light: 3 x 10^{16} of them pass through our bodies every second.

That combination of factors makes neutrinos the best focus for deep-space astronomy. Most photons cannot reach us from the most distant points in the universe (the most energetic ones cannot even make it from the edge of the galaxy: they crash into microwave background radiation along the way). And though radio waves routinely travel as far as neutrinos, they are emitted even by rather mundane astronomical objects—the moon, for instance. Neutrinos, on the other hand, not only travel long distances, they are easy to categorize: low-energy neutrinos are generated by the sun, by cosmic-ray collisions in the upper atmosphere, and by other nearby phenomena; high-energy neutrinos only reach the earth from distant, supremely violent events—gamma-ray bursts, for instance, or black holes at the centre of new galaxies. By focusing on high-energy neutrinos alone, a telescope can naturally filter out all but the most interesting things in the sky.

But there is no free lunch. If neutrinos can fly through planets without stopping, they hardly brake for your average telescope mirror. In fact, neutrinos are so hard to detect that for decades they existed only in theory. The Swiss theoretical physicist Wolfgang Pauli "invented" them in 1930 to balance out the energy apparently lost when radioactive matter decays. ("I have done a terrible thing," he told the German astronomer Walter Baade. "I have postulated a particle that cannot be detected.") It was not until twenty-six years later, when the physicists Frederick Reines and Clyde L. Cowan built a neutrino detector near the

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Looking into the camera as others prepare to lower AMANDA's optical modules into the ice.

Savannah River nuclear plant in South Carolina, that the existence of the particle was confirmed.

In the past four decades neutrino detectors of increasing scale and sensitivity have cropped up in odd spots around the globe: in an iron mine in Minnesota; underneath a mountain in Italy's Apennine range; in an abandoned railway tunnel on the outskirts of Osaka, Japan. None of them are really telescopes, however: rather than tracking high-energy neutrinos to map deep space, as AMANDA does, they simply detect low-energy neutrinos from the sun.

One might think that one or two solar neutrino detectors would be enough. But a single mystery has continued to tantalize investigators. According to standard astrophysical theory, nuclear fusion inside the sun ought to spawn a stable number of neutrinos, and so physicists ought to detect a predictable number of them. Instead, month after month, in detector after detector, no more than half of the expected neutrinos are counted. Are the detectors faulty, or does solar astrophysics need some revision? Neither one, most physicists now say. The flux of solar neutrinos is too weak because the particles transform themselves en route to the earth. What were once electron neutrinos become their particulate cousins: muon neutrinos and tau neutrinos, which most neutrino detectors cannot detect.

The fact that neutrinos come in three "flavours" is old and undisputed. But the idea that they oscillate between those three flavours entails a fundamental rethinking of their nature—and perhaps of the universe itself. According to the standard model of elementary particle physics, neutrinos have no mass at all. Yet according to quantum theory, only particles with mass can oscillate between one flavour and another. By recent estimates, there are about 100 million times as many neutrinos in the universe as there are protons and neutrons combined. Even if the mass of each neutrino is no more than a tenth of an electron volt, their collective mass would be as great as that of all the visible matter in the universe.

"Neutrino oscillations have been discovered at least four times and undiscovered at least twice," notes the particle physicist Donald H. Perkins of the University of Oxford. Last June, however, physicists in Takayama, Japan, announced results that have silenced most of the remaining doubters. Their Super-Kamiokande detector, built in a working zinc mine a kilometre underground, incorporates more than 13,000 photomultipliers to survey 50,000 tons of water for telltale flashes of light. (A photomultiplier looks like a lightbulb and works like a lightbulb in reverse: light goes in and electricity comes out. But what a lightbulb! The photomultipliers in Super-K amplify signals by a factor of 100 million.)

In principle, Super-K ought to detect equal numbers of low-energy neutrinos radiating in from all sides from the collisions of cosmic rays with the atmosphere. But in the past three years, the detector found that fewer neutrinos were coming in from the far side of the earth than from the near side. The only explanation for the discrepancy, the physicists concluded, was that some muon neutrinos, which Super-K can detect, must have changed into undetectable tau neutrinos as they passed through the earth.

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An optical module hits the surface of the water. Below it is a column of water that will hold a string of these modules. The column will freeze, holding the modules in place until the Antarctic ice melts.

The Super-K data are so precise, so elegantly conceived, that they seem to prove once and for all that neutrinos have mass—thereby punching a hole in one of the standard model's tires. Whether fixing that hole will require a simple patch or a complete overhaul remains to be seen: Super-K can only measure the difference in mass between two neutrinos—a quantity somewhere between 0.1 and 0.01 electron volt. Based on that figure and other data, however, many physicists now estimate that the three types of neutrinos have a combined mass of around 0.1 electron volt.

What Super-K does not do—what no working detector has ever done—is pay attention to neutrinos from beyond our galaxy. Enter AMANDA. Because high-energy neutrinos are 1012 times easier to detect than solar neutrinos, our telescope can afford to trade sensitivity for size. The same volume of water surveyed by 13,000 photomultipliers in Super-K is surveyed by only around ten in AMANDA; our photomultipliers are less than half as large; and ours do not detect solar neutrinos at all. But AMANDA, when complete, will watch over thousands of times more water than Super-K. As a result, it will track neutrinos across as far as a kilometre, whereas Super-K can track them across no more than fifty meters.

When a high-energy neutrino collides with a proton in the ice, it creates a muon—a particle closely related to the electron but more than 200 times more massive—that continues along the neutrino's upward path, streaming photons along its sides like a bottle rocket. The result is a hurtling cone of blue Cherenkov light—light of the same kind emitted by nuclear reactors. From the timing of the cone's reception by our grid of photomultipliers, the muon's direction can be reconstructed and the direction of the incoming neutrino inferred.

Why are we looking for neutrinos that have passed through the earth? Muons generated by cosmic rays also bombard the earth constantly from every direction, and some of them can

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The optical module submerged in water, nearly two miles below the surface of the ice.

travel through miles of ice before petering out. But no muon can cross the entire planet—as much as 8,000 miles of dense iron, magma and rock. Hence by pointing its photomultipliers downward, AMANDA uses the earth itself to screen out all upward-travelling muons except the ones thought to come from high-energy neutrinos.

AS EARLY AS THE 1960s, physicists had dreamed that radio antennas, operating near gigahertz frequencies, might listen in on the electric charges sparked by neutrinos crashing into ice. Thirty-five years later, however, working through the theory behind that idea, my colleagues and I showed that the radio signal created by the neutrinos was too weak to be of any use. It was then that I hit upon the obvious alternative: Why not try to detect the flash from a neutrino collision, rather than its noise?

I suspect that others must have contemplated the same idea and given up on it. Had I not been completely ignorant of what was then known about the optical properties of natural ice, I would probably have done the same. Instead, I sent off a flurry of E-mail messages to my friend John G. Learned, then the spokesperson for the Deep Underwater Muon and Neutrino Detector (DUMAND). Like AMANDA after it, DUMAND was designed to detect high energy muons—though in ocean water off the coast of Hawaii rather than in Antarctic ice. But though Learned's group had already deployed a test string of photomultipliers with some success, the project was eventually abandoned. (The DUMAND concept lives on, albeit at a smaller scale, in a detector now operating in the depths of Lake Baikal in Russia.)

Learned immediately appreciated the advantages of an Antarctic neutrino telescope. For starters, sinking the photomultipliers into ice would enable investigators to walk around on top of the experiment, as well as to keep all the fragile electronics at the surface. As a result, the neutrino signals could be identified with off-the-shelf electronics. Better yet, the ice would be geologically stable (Antarctica almost never has earthquakes) and completely dark. DUMAND did not have it so easy. Although the water off the Hawaiian coast is exceptionally clear and deep, Learned's group had to contend with waves, storms, background light from bioluminescent organisms and the radioactive decay of sea salt. Most important, NSF was already operating a research station at the geographical South Pole, with an infrastructure to rival that of a national particle physics laboratory. AMANDA, in other words, would be much cheaper and easier to build than DUMAND.

Still, convincing donors of the soundness of our idea was no simple matter: I was only a theorist, after all, with no experience building anything, and my collaborators, at least in the beginning, were very talented but very junior physicists at the University of California, Berkeley. Nevertheless, NSF was willing to give us the benefit of the doubt, and within a few years we had joined forces with eight other universities and three research laboratories in Belgium, Germany, Sweden and the United States. In 1990, as proof of principle, one of our teams sank a 200-meter-long strand of three photomultipliers into the packed snow of Greenland. The toy experiment detected muons. Then, in the Antarctic summer of 1992, our work began in earnest. ■

... to be continued

astro news: NASA extends Cassini's tour of Saturn

by David Shiga at NewScientist.com

Delighted with the success of its Cassini spacecraft, NASA has approved a two-year extension to the mission. The spacecraft will investigate hints that there is liquid water inside Saturn's moon Enceladus and explore uncharted territory on its exotic sibling Titan. Cassini will also witness a dramatic alignment of Saturn's rings with the Sun. "It's going to look infinitely cool," says Carolyn Porco, who heads the spacecraft's imaging team. "This is something humans have never seen before."

Cassini has orbited Saturn since July 2004. Its original four-year mission was scheduled to end in July this year but, as expected, NASA announced on Tuesday that the healthy spacecraft's mission will continue. It should run until July 2010 or later.

Anticipating the decision, the mission team has drawn up a packed schedule of observations and moon flybys for the spacecraft.

Saturn's moon Enceladus may harbour liquid water below its icy surface, making it a potential haven for life (Image: NASA/JPL/Space Science Institute)

One of the most exciting targets is Enceladus, a 500-kilometre ball of ice and rock that astonished scientists with jets of water vapour spewing from hot spots at its south pole. The discovery hinted that liquid water might be present beneath the moon's icy surface, perhaps allowing life to have gained a foothold there.

But some scientists argue that the water vapour is merely due to warm ice sublimating – changing directly from solid to gas. "We're desperate to know whether the jetting activity that we see at the South Pole is arising from bodies of liquid water," Porco told New Scientist.

Future observations by Cassini will help distinguish between the two possibilities. The team also plans to take the most detailed pictures yet of the source regions for the jets at the South Pole, showing features as small as 8 meters across. Altogether, Cassini will make seven flybys of Enceladus during the extended mission.

Cassini has also observed an unexpectedly large stream of charged particles coming from the 1120-kilometer-wide moon Dione, which hints that it may power jets too. Cassini will fly by Dione during the extended mission to find out. It will also visit Rhea and the mini moon Helene.

Mission scientists will continue peeling back the atmospheric haze that shrouds Saturn's largest moon, Titan, in mystery. Titan is slightly larger than the planet Mercury. Cassini has used radar to peer through the haze and map the moon's exotic surface, which appears to host lakes of liquid methane.

"We've found both dried and very likely liquid-filled lakes at the polar regions – who knows what else we're going to find," says Porco. Cassini will fly past Titan 26 more times during the extended mission, increasing the mapped area of its surface from 22% to 30%.

The spacecraft may also have the opportunity to beam back the most extraordinary images of Saturn's rings ever seen. On 11 August 2009, the rings will be aligned exactly edge-on to the Sun. Porco says this should allow Cassini to see subtle features like corrugations in the rings more clearly than ever before. The Cassini team hopes the spacecraft will operate for several years even after the extended mission, if it remains healthy. When it eventually runs out of fuel, there is talk of intentionally flying the probe into Saturn's atmosphere, where it could make some unique measurements before burning up. ■

astro news: Milky Way's black hole wakes up

from astronomy.com, provided by NASA's Goddard Space Flight Center

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 3 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* (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.

This Chandra image shows our galaxy's center. The location of the black hole, known as Sagittarius A*, is arrowed. *NASA/CXC/MIT/Frederick K. Baganoff et al.*

"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 realize that the black hole was far more active in the past. Perhaps it's just resting after a major outburst."

The new study, which will appear in the Publications of the Astronomical Society of Japan, combines results from Japan's Suzaku and ASCA X-ray satellites, NASA's Chandra X-ray Observatory, and the European Space Agency's 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.

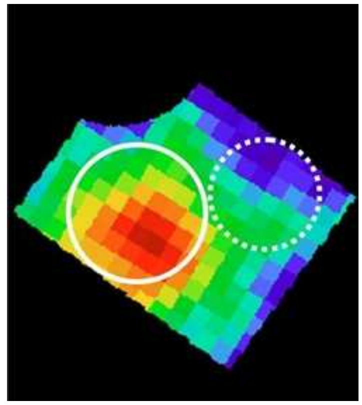
These X-ray pulses take 300 years to traverse the distance between the central black hole and a large cloud known as Sagittarius B2, so the cloud responds to events that occurred 300 years earlier. When the X-rays reach the cloud, they collide with iron atoms, kicking out electrons that are close to 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, 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 3 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, 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.

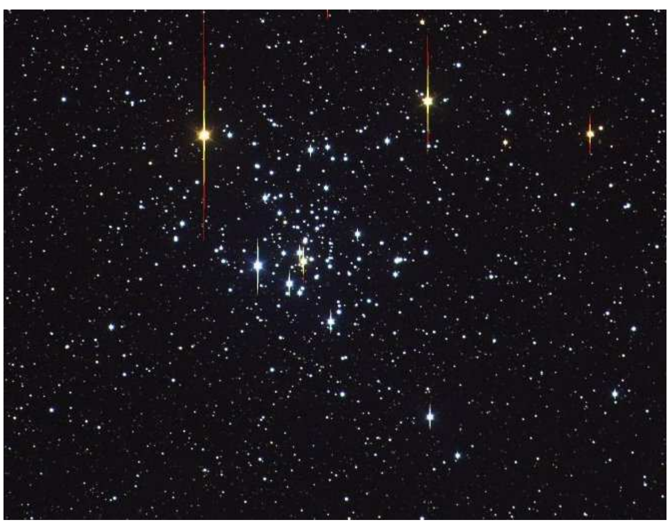
The galactic center is about 26,000 light-years from Earth, meaning we see events as they occurred 26,000 years ago. Astronomers still lack a detailed understanding of why Sagittarius A* varies so much in its activity. One possibility says Koyama, is that a supernova a few centuries ago plowed up gas 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. ■



An X-ray satellite imaged a small region in the gas cloud Sagittarius B2, and saw pockets brighten and fade over the course of nearly 12 years. These light echoes are caused by varying X-ray output from our galaxy's central black hole. *JAXA.*

focus on: NGC 2516 - star cluster with class

by Magda Streicher



Around the stars of the Carina false cross are ranged many open star clusters providing observational pleasure through binoculars as well as a telescope. One of the most exceptional star clusters in this part of the sky can only be attributed to NGC 2516, only 3 degrees SW of Epsilon Carinae.

Nicolas Louis de Lacaille (1713-63) discovered it in 1751 while observing from South Africa with a very small telescope. He noted NGC 2516 as a "very close group of 10 to 12 stars". Lacaille's residence in Stand Street, Cape Town, where he did many observations, is no longer there, going back many years. There is, however, a memorial stone against the marble wall entrance, which Auke Slotegraaf and I visited during a brief historical tour in Cape Town. The beautiful antique memorial stone was literally covered with green lichens and moss, which made it almost impossible to read. Auke, who has a great appreciation for history, went to find some water and a cloth and diligently set about cleaning the valuable memorial stone.

My observation of NGC 2516 indicates a beautiful, large, widely-spaced, slightly extended NW-SE open cluster, a good example of stars closely associated. Bright, individual stars stand out slightly more in the busier southern area of the cluster. The entire cluster is sprinkled with a variety of different-coloured stars, with a prominent chain of faint stars extended southwards. Numerous double stars are apparent in the cluster, which also sports the lovely red-coloured 6.6-magnitude SAO 250043 star positioned near the southern extreme. Two darker areas are also apparent in the east and west of the cluster centre. A beautiful example of a very rich open cluster.

Auke's comment on this cluster was, "What a sight!" He said this cluster had it all: multiple stars, curves, chains and coloured stars. He goes on by describing it as a glorious mass of stars in a rich field. The main body of the cluster is a regular-sided diamond, lying north-south/east-west, and filled with stars. A broad bridge of stars and stardust runs briefly northwards, and then branches east and west, each branch ending in an orange star. The bridge has a small but distinct black oval spot in its centre. On the east and west sides of the bridge are black vacancies, helping to define the bridge. The eastern tip of the diamond is capped by a bright off-white star. West of this star, near where the bridge of stars ends, is an almost equal double star.

Although Lacaille has long been dead, his memory will be with us in sharing this wonderful cluster with him once seen with his own eyes. ■

Object	**Name**	**Object**	**RA**	**DEC**	**MAG**	**SIZE**
NGC 2516		Open Cluster	07.58.3	-60°52	3.8	29'

canopus classifieds

Telescope:
Meade LX-50 8" Schmidt-Cassegrain telescope (complete) with a custom carry bag.

Extras include: 25mm Plossl eyepiece, 15m Series 4000 super plossl eyepiece, variable tele-extender, off-axis guider, T-adapter for Canon FD, variable polarising filter and a Red / White flashlight for reading during observations.

Contact: Michael Karakashian, Cell: +27 82 558 6629

the sky this month

site location: lat. **26.0 deg S** long. **28.0 deg E** local time = UT **+2.0 hrs**.

may 2008

dd hh				dd hh			
1	21	Uranus 3.1S of Moon		14	04	Mercury greatest elong E(22)	
3	13	Saturn stationary		17	04	Spica 2.3N of Moon	
4	21	Venus 5.9S of Moon		20	03	FULL MOON	
5	13	NEW MOON		20	13	Moon at apogee	
6	03	Moon at perigee		21	00	Antares 0.2N of Moon	Occn
6	22	Mercury 2.5S of Moon		24	13	Jupiter 2.5N of Moon	
9	15	Jupiter stationary		26	22	Neptune stationary	
10	02	Pollux 4.1N of Moon		26	23	Mercury stationary	
10	14	Mars 0.3S of Moon	Occn	27	04	Neptune 0.5S of Moon	Occn
12	04	FIRST QUARTER		28	04	LAST QUARTER	
12	19	Regulus 1.0N of Moon	Occn	29	07	Uranus 3.4S of Moon	
12	22	Saturn 2.5N of Moon					

june 2008

dd hh				dd hh			
2	01	Venus 5.2N of Aldebaran		13	09	Spica 2.5N of Moon	
3	13	Moon at perigee		16	20	Moon at apogee	
3	17	Venus 4.8S of Moon		17	06	Antares 0.2N of Moon	Occn
3	20	NEW MOON		18	18	FULL MOON	
6	11	Pollux 4.3N of Moon		19	14	Mercury stationary	
7	16	Mercury inferior conjunction		20	14	Jupiter 2.4N of Moon	
7	21	Mercury 2.9S of Venus		20	20	Pluto at opposition	
8	02	Mars 0.9N of Moon	Occn	21	00	Solstice	
9	02	Regulus 1.2N of Moon		23	09	Neptune 0.7S of Moon	Occn
9	05	Venus superior conjunction		25	14	Uranus 3.6S of Moon	
9	08	Saturn 2.8N of Moon		26	13	LAST QUARTER	
10	15	FIRST QUARTER		27	08	Uranus stationary	

local times of rise and set for the sun & major planets

Date	Sun		Mercury		Venus		Mars		Jupiter		Saturn	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
May 10	06.47	17.13	08.38	18.15	06.07	16.51	12.05	22.00	21.21	11.40	13.42	0.37
May 20	06.55	17.06	08.40	18.14	06.28	16.49	11.43	21.48	20.40	11.00	13.03	23.59
May 30	07.02	17.01	07.59	17.49	06.49	16.50	11.21	21.36	19.58	10.19	12.25	23.21
Jun 09	07.08	16.58	06.50	17.01	07.09	16.57	10.59	21.25	19.15	9.37	11.47	22.44
Jun 19	07.11	16.59	05.51	16.12	07.26	17.08	10.36	21.15	18.31	8.54	11.09	22.08
Jun 29	07.13	17.02	05.29	15.43	07.39	17.23	10.13	21.04	17.46	8.10	10.32	21.33

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