"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

JULY 2019

Monthly meeting This month's meeting will take place on **Monday 15 July** at the **Catholic Church Hall** starting at **19.00.** Dr Nicolas Erasmus from the SAAO in Cape Town will be talking on 'Near-Earth asteroids: monitoring close approaches and mitigating objects'. See below for more details.

Stargazing No event is planned for July.

WHAT'S UP?

Partial lunar eclipse Of the three solar and two lunar eclipses which take place during 2019, only the second lunar eclipse will be visible from South Africa. While the 21 January total eclipse only stars after the Moon has set in southern Africa, the later partial eclipse can be easily observed during the night of 16/17 July. The eclipse starts at 20.42 on the 16th and ends at 02.19 on the 17th. The middle of the event will take place around 23.30. As usual, the eclipse only occurs during Full Moon. In this case, Earth's shadow will block only a part of the lunar surface. As lunar eclipses are visible anywhere on Earth where the Moon is present at the time, in addition to Africa, this partial eclipse will also be visible from Europe (except the far north), Australia, and most of both Asia and South America. Five eclipses in one calendar year, as in 2019, fits comfortably within the normal range of four to seven events. At least two, and no more than five solar and lunar eclipses can occur in one year. While many can observe a lunar eclipse, the very narrow path of a solar eclipse means that these are visible to much smaller numbers. The next solar eclipse visible from southern Africa will take place on 21 June 2020.

LAST MONTH'S ACTIVITIES

Monthly centre meeting The presenter at the 24 June meeting was Centre member, Herbert Poller. He gave a fascinating presentation on 'The HESS project in Namibia'. A mechanical designer, Herbert was directly involved in the construction of the telescope frameworks for both HESS 1 and HESS 2. He gave a short introduction on the High Energy Stereoscopic Array, which images individual photons of very high energy(gamma) rays emitted by charged particles when they pass through Earth's atmosphere. This energy is called Cerenkov radiation.

Herbert then presented a detailed series of images taken during work done during construction, particularly of the HESS 2 telescope. The huge size of the metal frameworks which support the highly polished aluminium mirrors and large hi-tech cameras, and the extreme engineering precision involved in the tooling and assemblin of components was

breathtaking to see. The whole story was enriched by the fact that Herbert was central to the work. He told a story and gave personal insights and anecdotes which brought a very human perspective to what could simply be regarded as massive inanimate metal structures. This presentation demonstrated that, while it is easy to focus on telescope mirrors and the images they produce, the complex frameworks which both physically support the mirrors and produce the movements needed to enable the telescopes to operate also deserve attention and admiration.

Interest groups

Cosmology At the meeting on 3 June, Pierre Hugo presented the tenth part in the current series on 'Natural philosophy: science for non-scientists'. The topic was Gravity – spatial flow - part 2'.

Astro-photography At the 10 June meeting, attendees continued working on processing their own astro-images.

Other activities

Educational outreach

Hawston Secondary School Space Cadets No meetings took place during the school holidays.

Lukhanyo Youth Club Work continues on the construction of analemmatic sundials here and other schools in the Overstrand.

Stargazing No event took place in June. However, Caroline Gabb took this image of Jupiter and the 4 Galilean moons on 10 June, when Jupiter was in opposition to Earth and Sun. Thus, Jupiter was both at its closest to Earth, and at it brightest. The neat, symmetrical alignment of the Galilean moons was an added bonus. Caroline took the image with her Canon Powershot camera.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's meeting, will take place on **Monday 15 July** at the **Catholic Hall** starting **19.00**. Dr Nicolas Erasmus from the SAAO in Cape Town will be talking on ' 'Near-Earth asteroids: monitoring close approaches and mitigating objects'. He completed his PhD in femtosecond laser physics at the University of Stellenbosch. Currently, he is a postdoctoral fellow in the Instrumentation Division at the SAAO, working with Dr Amanda Sickafoose. His research interests are the study of near-earth asteroids (NEAs)

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting is on **Monday 1 July** at the **Catholic Hall**, starting at **19.00.** Pierre Hugo will lead the eleventh session in the series 'Natural philosophy: science for the non-scientist'. The topic will be 'General relativity'.

There is an entrance fee of R10 per person for members, R25 per person for non-members, and R10 for children, students and U3A members. For further information on these meetings, or any of the group's activities, please contact Pierre Hugo at pierre@hermanus.co.za

Astro-photography This group meets on the second Monday of each month. There is no meeting in July. The next meeting will be on **Monday 12 August.**

To find out more about the group's activities and the venue for particular meetings, please contact Deon Krige at astronomy.hermanus@gmail.com

Hermanus Youth Robotic Telescope Interest Group Developmental work on this will resume soon.

For further information, please contact Deon Krige at deonk@telkomsa.net

Other activities

Stargazing No events have been planned for June.

FUTURE TRIPS

Planning is underway for an outing later this year. Members will be sent details once the arrangements have been made.

2018 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month at the **Catholic Church Hall**, beginning at **19.00**.

15 July	'Near-Earth asteroids: monitoring close approaches and mitigating objects'. Presenter: Dr Nicolas Ersamus, SAAO, CT
19 August	'More unusual curvaceous geographical wonders of Earth'. Presenter: Jenny Morris, Centre member
16 September	Topic TBA. Presenter: Pierre de Villiers, Centre chairman
21 October	'Star formation and the gas cycle in galaxies'. Presenter: Dr Moses Mogotsi, SAAO., CT
18 November	'The Cassini family dynasty and their Saturnian legacy'. Presenter: Jenny Morris, centre member
9 December	TBA

ASTRONOMY SELF-GUIDED EDUCATION CENTRE (ASEC)

Work continues on planning and administrative requirements for work to begin on the proposed Astronomy Self-guided Education Centre, to be located within the existing whale-watching area at Gearing's Point.

The **Friends of the Observatory campaign** was launched several years ago when preliminary work began on plans to construct an astronomical observatory in Hermanus. Over the years, members have been very generous, for which we are deeply grateful. It may seem logical to assume that, now money has been awarded by the National Lotteries Board, pledge monies are no longer needed. Unfortunately, that is not the case. NLC funds can only be used once the plans have been formally approved by the Municipality.

We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular

monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer, The Standard Bank details are as follows:

Account name – Hermanus Astronomy Centre
Account number – 185 562 531
Branch code – 051001

If you make an online donation, please include the word 'pledge', and your name, unless you wish to remain anonymous.

ASTRONOMY NEWS\

Earth flyby gives astronomers close-up look at binary asteroid 5 June: A binary asteroid named 1999 KW4 passed some 5.2 million km from Earth on on 25 May, giving astronomers a good look at a space rock that will not come this close again for nearly two decades. The flyby brought it about 14 times farther away than our Moon, but still close enough for astronomers to study.

The European Southern Observatory's Very Large Telescope studied a double asteroid, shown here in an artist's illustration, during an Earth flyby in May. ESO/M. Kornmesser

The International Asteroid Warning Network (IAWN) organised the campaign, which included the European Space Agency, NASA, and the National Science Foundation, to observe the asteroid. The asteroid is less than 1.3 km in diameter, with a small 'moon following, and poses no real direct threat to Earth, though it is still classified as 'potentially hazardous', according to Goldstone Radar Observations Planning. Even though 1999 KW4 is not inherently dangerous, it looks a lot like another binary asteroid system that could pose a future threat. Looking toward 2022, NASA plans to try and slightly change the orbit of Didymos, a binary asteroid system that, while unlikely, could potentially threaten Earth.

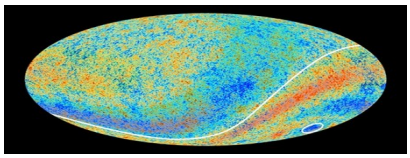
As Didymos passes close to Earth, NASA will arrive with a spacecraft to carry out their Double Asteroid Redirection Test (DASRT). The DART mission will be the first attempt to change the motion of an asteroid in space. NASA hopes that the deliberate collision of DART and Didymos will change the speed of the asteroid by a fraction of one percent. This will slow the orbit of Didymos by a few minutes, allowing astronomers to study Didymos better and rehearse what to do if there is an asteroid that poses a massive threat to Earth. "In the worst possible case, this knowledge is also essential to predict how an asteroid could interact with the atmosphere and Earth's surface, allowing us to mitigate damage in the event of a collision," said European Southern Observatory (ESO) astronomer, Oliver Hainaut.

To track 1999 KW4, astronomers used the Very Large Telescope (VLT) array in Northern Chile, which used SPHERE, an instrument equipped with a specialised camera and infrared technology that is normally used to find exoplanets. Through SPHERE, scientists were able to gather images sharp enough to make out the two separate components of 1999 KW4, which were orbit each other at a distance of about 2.6 km.

Observing the faint asteroid was particularly challenging for the team. Conditions were unstable at the time and the asteroid was moving at about 70,000 km/h. To make matters worse, the adaptive optics system - a special mirror design that lets astronomers counteract turbulent atmospheric conditions - crashed several times. Nonetheless, the

team prevailed and managed to use SPHERE's cameras to obtain the sharpest photos ever of the binary system. By: Halley Rose Mclughlin

The mystery of cosmic cold spots just got even weirder 6 June: During its time in orbit, the European Space Agency's Planck spacecraft gave humanity the most sophisticated measurements ever made of the cosmic microwave background (CMB) radiation, the first flash of light that rippled across the universe after the Big Bang. Plank told us the shape of the universe and confirmed crucial components of the Big Bang as it collected data between 2009 and 2013. It did all that by measuring the intensity of the CMB across the sky. Snce then, astronomers have kept putting out new maps of the cosmos as they mine data and discover new ways to tease out secrets.


Recent analysis of Planck data upholds mysteries that have existed since the spacecraft's first results in 2013. ESA/Planck Collaboration

While Planck's measurements in large part confirmed physicists' understanding of the universe, some of the most interesting things Planck discovered were the unexpected details. For one, the universe seems divided into two hemispheres, one hot and one cold. The hot hemisphere also contains a stark cold spot. Neither of these details was predicted, and should not, in fact, exist, according to the so-called standard cosmological model, which otherwise well describes the universe as viewed by Planck. The third surprise is the very slight way Planck's measurements stray from the standard model, only at large scales. While earlier spacecraft had hinted at all these issues, Planck confirmed them for scientists, bringing into high resolution a problem many researchers had hoped would instead fade away with increased precision.

Now, scientists have compared Planck's map of those temperature anomalies – where space itself is just slightly warmer or cooler than the average of just above absolute zero – to a map of the sky's polarisation. This second map holds a record of how the light scattered across the sky just 380,000 years after the Big Bang. Researchers hoped the polarisation map could answer questions about the meaning of the anomalies they had been watching in the temperature maps by either strongly echoing them or not showing them at all. However, the polarisation map shows either no or faint evidence of the anomalies, leaving scientists still wondering. Are the signals saying something important about the makeup of our universe or, are they merely random fluctuations in space, signifying nothing at all?

In the temperature maps, researchers had noted suspicious anomalies that show up at large scales – some 10 times bigger than the full Moon on the sky. These temperature variations do not match with standard explanations of the universe's physics as we know it. Scientists have also proven that the features are not due to observing quirks of their telescope. They are, however, just faint enough that these cold spots could possibly be random – while also being just strong enough that scientists can't quite ignore them. Their appearance hints that something about the standard cosmological model is not quite right.

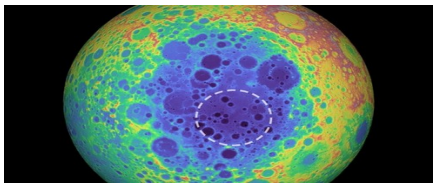
Because the polarisation map is a largely independent measurement of the sky (though taken with the same spacecraft), scientists hoped it could shed light on whether the

anomalies were a true signal of something previously unknown about the universe, or simply a random fluctuation. Unfortunately, when they compared the most advanced maps that Planck has produced, they found only faint evidence of the anomalies. That is, the spots appear, but not in a statistically significant way.

This leaves scientists stuck with two possibilities. The first is that the anomalies are simply flukes of statistics – stronger than suggested by physics, but still just random, the way coin flips do not always turn up exactly 50/50, even after 1,000 tries. The other possibility is some kind of new physics not currently explained by the standard model. That option is less likely now, given the polarisation maps did not show the anomalies very clearly. However, they do show faint signs of the signals, and because scientists do not know what this new physics might be, there is no way for them to know if it should show up in both polarisation and temperature maps.

Planck is not taking new data, and scientists have probably produced the most detailed maps they can from the available information. While clever ideas may yet emerge, solving this mystery with new information will likely have to wait another decade or more, until a new generation of CMB-spying spacecraft take to the skies. By: Korey Haynes

There's an enormous, mysterious mass under the Moon's largest crater 11 June: Buried under the largest, oldest crater on the Moon, scientists have discovered an enormous mass of dense material, possibly the remains of the asteroid that formed the crater some 4 billion years ago.


The South Pole-Aitken basin shows up clearly as low-lying blue in a topographical map of the moon, with the newly discovered mass located underneath the area encircled by the dotted line. NASA/Goddard Space Flight Center/University of Arizona

Astronomers led by Peter B. James from Baylor University discovered the hidden feature by combining data from NASA's GRAIL lunar orbiter mission and the Lunar Reconnaissance Orbiter to look at where regions of high gravity - and therefore mass - overlap with surface features like craters. They found a giant mass weighing down the floor of the South Pole-Aitken basin by more than 0.8 km. "Imagine taking a pile of metal five times larger than the Big Island of Hawaii and burying it underground. That's roughly how much unexpected mass we detected," James said.

James and his colleagues suggest that one possible explanation for the underground material is that it is the remains of a massive asteroid that slammed into the Moon soon after its formation, causing the giant impact crater still visible today. The South Pole-Aitken basin is the oldest crater on the Moon – it is covered with newer, smaller impact scars, but still clearly visible. The basin is one of the largest and best-preserved craters in the entire solar system, covering nearly a quarter of the Moon's surface. The asteroid that made the impact would also have been large, perhaps 160 kma across.

James' research suggests that the nickel and iron that made up the asteroid could have stayed embedded in the Moon's middle layers, rather than sinking into the denser core

over the aeons. That would yield something like the large mass they see today, which sits underneath the same area it impacted and blew apart so long ago. Alternatively, the mass may be a dense region caused by the Moon's magma ocean solidifying as our satellite cooled and aged. By: Korey Haynes

NASA is retiring its legendary Spitzer Space Telescope 13 June: NASA's Spitzer Space Telescope was launched in 2003 on a mission to spend five years exploring the cosmos in infrared light. That means it excels at capturing images and chemical signatures of warm objects, like the glow of gas in nebulae and galaxies, or the composition of planets in still-forming alien solar systems. It even found a new ring of Saturn. In recent years, it has been operating with just one instrument, as the other two succumbed to the elements and ceased functioning. Despite its diminished capacity, the telescope is still delivering ground-breaking science. Now, NASA has finally decided to shut down the aging telescope. It will be switched off on 30 Januayr 2020.


The Iris Nebula is captured here by Spitzer. NASA/JPL-Caltech

That the telescope has lasted this long is a testament to the engineers at the Jet Propulsion Laboratory, who have adapted with the telescope's age to keep it functioning as best they could.


The Cat's Paw Nebula shines in light human eyes cannot see, but Spitzer can. NASA/JPL-Caltech

As with other infrared telescopes, Spitzer is sensitive to heat. Even the tiny amount of heat generated by its own electronics, and the glare of sunlight as it orbits, can create noise in its images. That' is why the telescope was designed to fly far from Earth's own warmth, and reflect sunlight back without absorbing any more energy than it needs to power itself. It also carried coolant to keep its instrumentation chilled, though it needed less than previous telescopes due to its clever design and orbit. Still, that coolant ran out back in 2009, rendering two of its instruments useless. Since then, its been running in what engineers call 'warm mode', with only two of the original four light wavelength windows available on its remaining instrument.

Due to its distant, Earth-trailing orbit, Spitzer has also drifted farther from Earth over time. It is now about 600 times the Earth-Moon distance from us, and the angles between Spitzer, Earth, and the sun have shifted since the mission's start. That makes sending data back to Earth a problem. The telescope cannot charge its solar panels and communicate with Earth at the same time due to a geometric mismatch between its solar and communication arrays, and it only has so much battery life. So, it can only point to Earth for 2.5 hours at a time before it must turn back to the sun and recharge. That window will only grow shorter as the spacecraft continues to drift farther behind Earth.

On top of the time limitation, the angle Spitzer must turn to talk to Earth at all these days

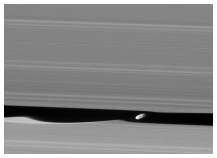
is beyond its original limits. Engineers have had to turn off certain safety protocols to tilt the spacecraft toward Earth as the angle between them has changed. If the spacecraft were to put itself in safe mode, engineers worry it may never emerge, thanks to ageing systems and the increasing difficulty of communicating with the spacecraft.

In its time, Spitzer was one of NASA's premier space telescopes, classified among the space agency's 'Great Observatories' alongside Hubble, Compton Gamma Ray Observatory, and the Chandra X-Ray Observatory. Spitzer revealed breathtaking views of otherwise invisible materials swirling through the cosmos. It captured galaxies from the early days of the universe, their light shifted and stretched over the aeons from bright ultraviolet light then to a dimmer infrared glow now. For nearer galaxies, Spitzer has helped pinpoint where rich dust lanes lay, and where star formation is churning out piles of baby stars. Spitzer was also the first telescope to directly detect an exoplanet, picking up the light from HD 209458b in 2005. Until then, every exoplanet detection had been indirect, based on the wobble or transit of the star.

While generally considered a successor to Hubble, the upcoming James Webb Space Telescope is mostly an infrared instrument, and will pick up where Spitzer leaves off. With a primary mirror 7.5 times larger than Spitzer's, JWST will see the universe though much of the same light, but with far greater precision. "There have been times when the Spitzer mission could have ended in a way we didn't plan for," said Bolinda Kahr, Spitzer's mission manager. "I'm glad that in January we'll be able to retire the spacecraft deliberately, the way we want to do it." By: Korey Haynes

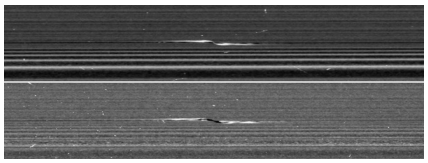
Propellers, waves, and gaps: Cassini's last looks at Saturn's rings 13 June: Since Cassini plunged into Saturn's atmosphere in 2017, ending its 13-year mission, scientists have continued to comb through the rich store of data it sent back, especially during its last year, when it dove closer to Saturn's rings than ever before. Among the findings are a deep look at the complex ring system, which hid more structure than scientists expected, including 'straw-like' texture, tiny gaps shaped like propellers, and wavy, sculpted edges to the rings. Scientists still do not know what causes some of these structures, something we may need to wait until the next big Saturn mission to find out.

Among the more concrete findings, scientists have realised the rings are less massive by half than they thought, and also that the rings are possibly quite young – maybe as young as 10 million years. This has big implications for how the ring system formed, and how it continues to evolve. Of immediate interest to scientists was how finely-detailed the structure of Saturn's rings is. Linda Spilker of NASA's Jet Propulsion Laboratory, who co-authored one of the research papers and wrote a review of the Cassini mission published today, says that as they zoomed in closer and closer they kept seeing ever more intricate patterns. During those last, close approaches, Cassini was viewing the rings at a resolution of less than a mile per pixel, and new features were still appearing.


Saturn's small moon Daphnis sculpts the edge of its gap as it moves among Saturn's rings. NASA/JPL-Caltech/Space Science Institute

"What's really intriguing is finding these textures in the rings," Spilker says. "We call them streaky or clumpy or straw-like. They have very sharp boundaries, and we're trying to understand why they're so sharp. They don't correlate with anything obvious." The differences do not appear to be due to particles clumping or different types of materials, but they could be due to changes in particle size throughout the rings. Scientists do not know why the particles would self-sort into such narrow, well-defined bands. "It's a puzzle," Spilker says.

The other small features researchers noticed are called propellers, due to their shapes. These are small gaps opened up in the rings by tiny moonlets, only a few thousand feet across. In fact, researchers do not even see the moonlets themselves in Cassini images, only the gaps they create. They can watch these gaps move around in the rings. "They tend to move a little closer to Saturn and sometimes they move outward. It's not any predictable pattern," Spilker says.


Propellers are small gaps in the rings opened up by mountain-sized moons. NASA/JPL-Caltech/Space Science Institute

She likens the moonlets to the rocky planetesimals that glommed together to form the planets, back when the solar system was young. Young stars are usually surrounded by flat disks of dust and debris, out of which planets are thought to form. A similar process seems to be happening around Saturn. "How the propellers interact is then telling us how the astrophysical disks might interact. Saturn's rings are an analogy for that disk of material," Spilker says.

The age and unexpectedly small mass of Saturn's rings are also fodder for new theories. Scientists still are not sure where Saturn's rings came from. Have they been there since the beginning, 4.5 billion years ago, slowly forming moons out of dust and ice like a miniature solar system? Or are they a more recent feature, caused by Saturn tearing apart some interloper asteroid body within the last billion years? Now, the most recent evidence suggests the rings appear to be relatively young – perhaps as young as 10 million years. However, it is possible they also get resurfaced with icy material from geysers on Saturn's moon Enceladus, preserving their fresh appearance and hiding signs of aging caused by radiation and dust.

Spilker says the new data does prove a more complex relationship between the moon and ring systems. "We're getting a much better handle on how moons affect the rings, and how the propeller moons migrate. It's a gradation between the moons and the moonlets." She also points out that many of the moons embedded in the gaps of Saturn's rings, such as Pan, Daphnis and Atlas, have their own skirts of ring particles, like tiny Saturns themselves. By: Korey Haynes

The Hubble Telescope's successor inches closer to launch 19 June: The James Webb Space Telescope (JWST) is NASA's long-planned – and long-delayed – successor to Hubble. After a recent spate of testing to mimic the extremes of space, it is looking like the telescope is still on track for its 2021 launch date. The telescope itself, along with its instrumentation, passed many of its final tests last year, before being delivered to

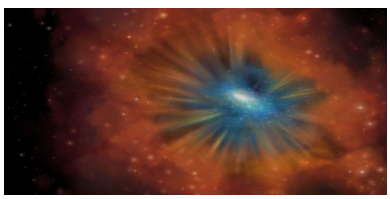
Northrup Grumman in Los Angeles. Now, the spacecraft part of the satellite has also finished similar tests, ensuring that it can safely withstand the violent temperature swings and zero-pressure environment in space.

JWST will be a huge leap forward for space telescopes. With a mirror 6.5 times the area of Hubble's, JWST will be able to see farther and with greater precision than its predecessor. However, the upcoming observatory is too big to fit into any current rockets in its final form. So, engineers have had to design parts of it to fold up like an origami work of art. This goes especially for the large sunshield, which protects sensitive instruments from the Sun's heat and light and takes up as much space as a tennis field. After launch, the spacecraft will slowly unfold, with engineers checking in on the satellite at every step. Engineers practised the spacecraft's ability to fold the sunshield and stow it before it underwent environmental testing. The most dangerous period for JWST will be its launch and initial exposure to the harsh environment of space, so testing it in this folded-up configuration replicates how conditions will be during launch.

Once in the testing room, researchers subjected the spacecraft to the same tests the telescope received last year in Houston. These tests sucked air from the room to simulate the lack of pressure in space, plunged JWST to minus 148 degrees Celsius, and then heated it to 102 degrees Celsius. So far, the spacecraft has braved the harsh conditions well, and is on track to continue tests in advance of its launch sometime in 2021.

JWST's next challenge will be to test the entire configuration. Engineers will join the telescope and spacecraft, and run a final round of tests before they can declare it ready for launch. If that too proceeds smoothly, then NASA can ship JWST to its launch site near Kourou, French Guiana. Once there, an Ariane 5 rocket will carry the telescope to space, where it can spread its sunshield in the environment it was built for. By: Korey Haynes

Astronomers discover a new stage of galaxy evolution — the 'cold quasar' 20 June: Quasars are supermassive black holes actively gobbling material from the galaxy around them. While black holes are known for pulling material in, the turbulent swirl of that whirlpool often also flings material and radiation out at high energies, enabling quasars to be seen from across the universe. They are some of the brightest objects astronomers know. However, a quasar can be bad news for its host galaxy. To form stars, a galaxy needs reservoirs of cold gas that can clump together, not gas that is being violently heated and swept away by a raging black hole. So, galaxies containing quasars are thought to be at the end of their productive lives, no longer capable of forming stars. However, Allison Kirkpatrick, from the University of Kansas, recently revealed a whole set of galaxies that contain both violent quasars and cold pools of gas - meaning they might yet be capable of making new stars in their old age.


Artist's image of the powerful quasar blowing away material immediately around it, Michelle Vigeant

Kirkpatrick looked at data from the Sloan Digital Sky Survey, a massive investigation of the entire sky at various wavelengths, picking out all the quasars in one particular region. She

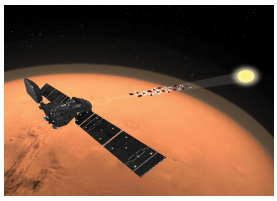
then matched those quasars to ones found by both the XXM-Newton X-Ray Space Telescope and the Herschel Space Observatory, which looks at the sky in infrared light. X-rays are high-energy radiation, and a good marker of active black holes. Infrared, on the other end, is a lower-energy type of radiation emitted by glowing gas and dust.

It is common to find quasars enshrouded in a cloud of dust and gas - researchers think this is an intermediate phase, when the quasar has turned on but has not yet had time to blow away the dust and gas around it. However, because these quasars are surrounded by extra material that absorbs much of the energy from the quasar itself, they show up as reddish, obscured objects. What Kirkpatrick found are bright blue luminous quasars that nonetheless have cold gas signatures as well. That implies that they have blown away the dust and gas immediately around them, but not entirely out of the galaxy.

Kirkpatrick theorises that this is another intermediate phase, even shorter than the red, obscured phase. Lasting perhaps only 10 million years - the blink of an eye in the lifespan of a galaxy - it could be that the reason these cold quasars appear rare is that they simply don't stay in this phase very long. Kirkpatrick is not sure yet if this is a stage most or all galaxies move through, or if only certain galaxies will ever appear as cold quasars. To do that, she will have to do an even wider search, netting yet more of these new cold quasars.

By: Korey Haynes

Curiosity detects methane spike on Mars again, but what does it mean? 25 June: Last week, NASA's Mars Curiosity rover detected a sudden spike in methane levels, which kickstarted excitement about the prospects of life on the Red Planet.

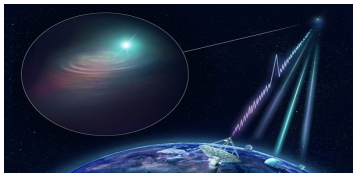


Spacecraft have been both finding and not finding methane around Mars for years. ESA/ATG medialab

On Earth, the most common source of methane is biological organisms, from cows and humans down to single-celled creatures, making its detection on the Red Planet a reason for excitement and intrigue. However, it is quite possible to produce methane from non-biological reactions between water and rocks, so researchers are cautioning that the evidence as it stands does not yet herald the presence of life on Mars. This is not the first time a rover or orbiter has found methane on the Red Planet – indeed, earlier this year, NASA confirmed that both a rover and orbiter independently reported the same methane spike in 2013. The plumes have appeared and disappeared through the years, in tantalising puffs that researchers have found difficult to study or even verify.
The most recent spike is larger than Curiosity has ever seen before. However, NASA is still being cautious. "With our current measurements, we have no way of telling if the methane source is biology or geology, or even ancient or modern," said Paul Mahaffy of NASA's Goddard Spaceflight Centre. Mahaffy and his team are in charge of Curiosity's Sample Analysis at Mars (SAM), a large suite of instruments attached to the rover. They quickly reconfigured Curiosity's tasks for the weekend to try to better understand the methane seen just days ago. The methane spike had dropped sharply, to levels of less than 1 part per billion, a normal background level for Mars.

In the past, these plumes have appeared and disappeared quickly, but that in itself can be a clue to researchers. The European Space Agency's ExoMars spacecraft has failed to find any methane traces in the atmosphere, leading astronomers to suspect some previously unknown mechanism that can quickly remove methane from the skies. Researchers' standard understanding of Mars' atmospheric chemistry is that the methane should remain for hundreds of years. However, that does not match the quickly disappearing methane that various instruments keep finding and then losing. "The methane mystery continues," said Ashwin Vasavada, from the Curiosity team at NASA's Jet Propulsion Laboratory. "We're more motivated than ever to keep measuring and put our brains together to figure out how methane behaves in the Martian atmosphere." By: Korey Haynes

Astronomers pinpoint location of a single fast radio burst for the first time 27 June: Fast radio bursts (FRBs) are one of space's great mysteries. Discovered for the first time only in 2007, they are massively powerful bursts of radio waves that last for just a fraction of a second. The vast majority of these signals occur once, and then never happen again – making them especially hard to track and study. Scientists know that whatever produces the FRBs must be a highly energetic event, but without knowing where these busts come from, the actual creation of these brilliant flashes remains unknown.


The ASKAP radio telescope is the first to pinpoint the source of a non-repeating fast radio burst. CSIRO/Andrew Howells

In 2017, researchers tracked one burst, called FRB 121102, to a tiny yet active galaxy. However, that was an even rarer repeating FRB, which gave scientists multiple tries at pinning down its location. Now, astronomers using Australia's Square Kilometre Array Pathfinder radio observatory (ASKAP) have managed to zero in on the location of a non-repeating burst, FRB 180924. Finding it was a much tougher challenge. They discovered that the FRB came from a quiet galaxy entirely unlike that of the repeating burst, making the finding both exciting and unexpected. The research was led by Keith Bannister from Australia's Commonwealth Science and Industrial Research Organization (CSIRO).

For a dozen years, astronomers have been drawn to FRBs by their extremely bright and mysterious nature. "They're amazingly bright," Bannister says. While there are something like 1,000 FRBs every day, astronomers cannot watch the whole sky all at once. Most FRBs flash for a few millisecs then never again; catching one relies on luck and patience.

The ASKAP array has been at the forefront of this FRB search. Made of 36 telescopes spread over nearly four miles, the observatory has discovered almost one-third of the 86 known FRBs. Most of the time, the 36 telescopes spread their gaze across the sky, looking at a wide field. However, for this latest discovery, the telescopes happened to be pointing in the roughly same direction, observing an area that covered just one-tenth of one percent of the sky. That tiny slice makes it less likely to catch an FRB, but it also meant that, when the signal arrived, the network had 36 different telescopes observing it. The system is set to automatically identify a FRB within a half second, at which point every receiver freezes and sends the last three seconds of observations, which researchers can then comb over like referees checking 36 separate instant replay devices.

The radio waves travelled very slightly different distances to reach each telescope, so they struck each receiver at a different time and angle. That let astronomers triangulate the FRB's origin. Researchers then used data from some of the world's largest optical telescopes - Keck in Hawaii and Gemini South and the European Southern Observatory's Very Large Telescope, both in Chile - to image the region and learn more about the FRB's home. Astronomers found that this FRB came from a quiet, elderly galaxy nearly 4 billion light-years away, designated only as DES J214425.25–405400.81. Nearly the size of the Milky Way, this galaxy does not have much gas – the fuel for star formation – and seems to be mostly finished making new stars. That rules out a lot of possibilities for what might cause a FRB, since young stellar populations are where astronomers usually see exciting, high-energy events like supernovas that might plausibly make a FRB. Even more interestingly, they traced the FRB to the outskirts of the galaxy, some 13,000 light-years from its centre. That matters because the supermassive black holes that reside at the center of most large galaxies were thought to be another possible way to fire off an FRB. But it's not possible in this case, thanks to the large offset from the galaxy's centre.

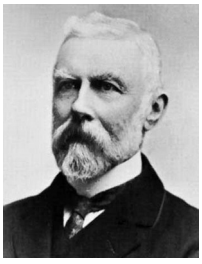
The only other FRB to ever be traced to its source was a repeating burst, one of only two so far discovered. Scientists are not sure if repeaters are caused by the same kind of event as these solo bursts, but the two examples they have – one repeating, one not – are as different as can be. In 2017, researchers traced the repeating FRB to a tiny dwarf galaxy one thousand times smaller than the Milky Way, which churns out new stars at a high rate. What's more, even when this prior FRB source is quiet, its galaxy sends out a persistent, though quieter, radio signal that matches up with the location of the FRB. "When we look," Bannister says of his new lone FRB, "there's no persistent radio source." About the only thing the two sources have in common is that they are short, bright radio bursts, and they are coming from outside the Milky Way. "There's either a huge continuum, or they're just a different class of object entirely," says Bannister of the two FRBs.

One of the mechanisms still on the table for creating FRBs is the creation of a magnetar, the dense core leftover after the death of a massive star that sends out powerful magnetic signals. They usually happen at the end of a large star's (short) lifetime, but they can also form when two white dwarfs – the remnant cores of two smaller, longer-lived stars – collide with one another. That scenario is more likely in the older galaxy hosting Bannister's FRB. However,it's still just a theory. By: Korey Haynes

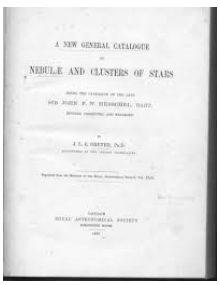
Source of these and further astronomy news items: www.astronomy.com/news

DID YOU KNOW

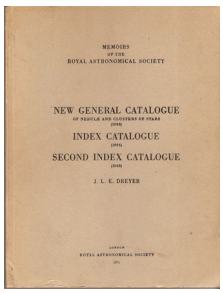
Astronomical catalogues Part 9: John Dreyer's catalogues – introduced the deep sky object labelling system still in use



John Dreyer



First edition of NGC



NGC and IC

NGC 1952

NGC 4594

John Dreyer (1852 – 1926) was born in Denmark. At the age of 14, he developed an interest in astronomy and regularly visited the Copenhagen Observatory. In his early twenties, he moved to Ireland. He spent a few years at two observatories before moving to Armagh, where he was director from 1882 until his retirement in 1916. Although his name may not be widely known, his work is found in every written and verbal mention of an NGC or IC number when identifying a deep sky object.

Dreyer's catalogues grew from John Herschel's 1864 *General Catalogue of Nebulae and Clusters of Stars.* After publishing a *supplement to the General Catalogue* in 1878, he proposed another one in 1886. The British Astronomical Society's response was to ask him to compile a new version instead.

The *New General Catalogue of Nebulae and Clusters of Stars* was published just two years later, in 1888. Colloquially called the *New General Catalogue* or NGC, it used the Herschel's and others' observations. It was a challenge to produce. Dreyer had to deal with many contradictory and unclear records based on data obtained from a variety of telescopes with apertures varying from 2 – 72". Although he did check some details himself, Dreyer had to largely rely on others' records. Thus, despite Dreyer being a very accurate transcriber, the first edition of the NGC was not error-free. However, his very thorough referencing enabled later astronomers to review original material, and publish corrections.

The first NGC contained 7,840 northern and southern hemisphere galaxies, nebulae and star clusters, most of themHerschel discoveries. James Dunlop's catalogues also provided additional information on southern hemisphere objects. One of the then largest comprehensive catalogues, it included all types of deep sky objects. The objects are listed in order of right ascension. Each has the prefix NGC, followed by its unique four-part number eg NGC 1952 for the Crab nebula. Over time, objects in the catalogue became known as 'NGC objects'.

Dreyer later also published two supplements. An additional 5,386 objects were listed in the 2 parts of the *Index Catalogue of Nebulae and Clusters of Stars* (IC). The 1895 IC contained 1,520 objects, and the 1905 IC listed objects. These added new discoveries made from 1888 – 1907, mostly using photographic records. These 'IC objects' are still known by their IC numbers.

Despite attempts at accuracy, the NGC and IC both contained numerous errors. The *Revised New General Catalogue* (RNGC), published in 1973, attempted to address these. However, it was, itself, flawed, as the compilers failed to incorporate several previously published NGC corrections, including those published by Dreyer. It also introduced new errors.

The 1988 NGC2000.0 project continued the work of improving the catalogues. The *Complete New General Catalogue and Index Catalogue of Nebulae and Star Clusters* did incorporate several corrections and omissions. However, its compilers, too, ignored original publications, favouring modern, but inaccurate corrections. A 1993 NGC/IC collaboration aimed to eliminate all errors. The project began well, but was not completed.

Finally, in 2009, the *Revised New General Catalogue and Index Catalogues* (RNGS/IC) was published. It is considered to be the most comprehensive and authoritative of the NGC and IC catalogues. This late success demonstrates how well Dreyer did to produce the

original NGC and IC with the limited technology and resources available to him in the late 19th century.

Sources: Ridpath, I (Ed) (2012) Oxford dictionary of astronomy 2nd ed rev, www.en.wikipedia.org

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