`"The Southern Cross"

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HERMANUS ASTRONOMY CENTRE NEWSLETTER

MAY 2020

Monthly meeting There will be no meeting in May due to the coronavirus pandemic.

Stargazing Two members had their telescopes and cameras out during the supermoon on 8 April. See below for details and the wonderful images.

2020 meeting dates For your diaries. Remaining meeting dates are: **22 June**, 20 July, 17 August, 21 September, 19 October and 16 November. **Note:** the June date has been changed because of the long weekend the previous week.

WHAT'S UP?

Venus and Mercury duet From 24-30 May, these two inner planets can be seen close to each other low to the West before sunset. These rocky planets oth have phases, but they are also different in several ways. Venus is much larger, over twice the diameter of Mercury (12,104 v 4,879 km). Mercury has virtually no atmosphere, and its scarred, crater covered surface is visible. In contrast, Venus has a thick, hot atmosphere which hides its surface features from view. While Venus has the most circular orbit of the major planets, Mercury's is the most elliptic. Although Mercury's orbit is closer to the Sun than Venus's (57.9 million v 108.2 million km, on average), the complexities of orbital shape and planetary positions mean that Venus is not always actually the closer of the two planets to Earth. Analysis of almost 900 years of data has shown that, although Venus comes closest to Earth, it is Mercury which, on average, is the closest planet to Earth.

LAST MONTH'S ACTIVITIES

Monthly centre meeting No meeting took place in April, due to the coronavirus pandemic.

Interest groups

Cosmology No meeting took place in April, due to the coronavirus pandemic.

Astro-photography No meeting took place in April, due to the coronavirus pandemic.

Other activities

Educational outreach

Analemmatic sundials at schools When possible, work will continue on these at several Overstrand schools.

Stargazing Full moon on 8 April was a supermoon, a result of the lunar orbit bringing the Moon closer to Earth. Two members took spectacular images, marking the event.

Derek Duckitt reported: 'My image of the so-called super pink Moon. Taken at 250mm zoom with Nikon D7100, ISO 100, F11, manual focus using Bahtinov mask, 3 images merged in Photoshop taken at 1/400th, 1/500th and 1/640 seconds and processed in Lightroom and Photoshop.

A little later, Johan Retief responded: 'Derek's photo infected me to also take a photo, The moon was still 99% full at the time last time (22h13). Details as follows - 1/200 sec at ISO 800 and F18. Processed with PhotoScape only.
Comments: I used a too high ISO setting with the result that the SW quadrant of the Moon is overexposed and one can hardly see Tycho. I had problems focussing and decided to use a very small aperture (f18) to increase the depth of field.

This supermoon was also described as a 'pink' Moon. This was misleading, as it suggested that the Moon, itself, would look pink. If so, this would have been a result of moonlight passing through particles in Earth's atmosphere creating such an effect. The origin of a 'pink' full moon in April is cultural. It is a Northern Hemisphere Native American reference to an early-blooming wildflower, first seen across North America as spring begins.

Similarly, the June full Moon is often described as a 'strawberry moon' because some native American tribes used it to indicate the time to start picking strawberries. The term only really applies in the Northern Hemisphere; very few strawberries ready for picking at this time of year in the south.

THIS MONTH'S ACTIVITIES

Monthly centre meeting

The presentation scheduled for 18 May has been cancelled, due to the coronavirus pandemic.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. There will be no meeting in May, due to the coronavirus pandemic.

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 Derek Duckitt at derek.duckitt@gmail.com

Astro-photography This group meets on the second Monday of each month. There will be no meeting in May, due to the coronavirus pandemic.

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 There is no update.

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

Other activities

Stargazing No events will take place during the coronavirus pandic.

FUTURE TRIPS

No outings are being planned, at present.

2019 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month at the **Catholic Church Hall**, beginning at **19.00**. Details for the first part of the year are:

18 May	Cancelled
22 June	Topic: TBA. Presenter: Dr Kechil Kirkham, IDIA, CT
20 July	'Designing and building a mobile home observatory." Presenter: Pierre de Villiers, Centre chariman
17 Aug	'Further unusual curvaceous geographical wonders of Earth." Presenter: Jenny Morris, Centre member
21 Sept	Topic: TBA. Presenter: Eddy Nijeboer, Cape Centre, CT
19 Oct	'Cosmic ray astronomy.' Presenter: Dr Pieter Kotze, SANSA
16 Nov	'1820 and all that: Establishment of the observatory, and scientific connections with the Cape' Presenter: Jenny Morris, Centre member

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:

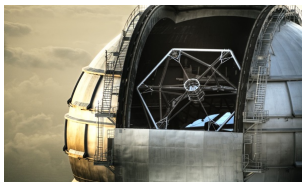
Account name – Hermanus Astronomy Centre
Account number – 185 562 531
Branch code – 051001

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

ASTRONOMY NEWS\

COVID-19 forces Earth's largest telescopes to close 7 April: The alarm sounded at around 3 am on 3 April. An electrical malfunction had stalled the behemoth South Pole Telescope as it mapped radiation left over from the Big Bang. Astronomers Allen Foster and Geoffrey Chen crawled out of bed and got dressed to shield themselves from the -

50ºC temperatures outside. They then trekked a few thousand feet across the ice to restart the telescope. The Sun set weeks ago in Antarctica. Daylight will not return for six months. Yet, life at the bottom of the planet has not changed much - even as the rest of the world has been turned upside-down. The last flight from the region left on 15 February so there is no need for social distancing. The 42 'winterovers' still work together. They still eat together, share the gym, even play roller hockey most nights. That is why South Pole Telescope is one of the last large observatories still monitoring the night sky.


Earth's largest optical telescope, the Gran Telescopio Canarias, is closed due to COVID-19. Instituto de Astrofísica de Canarias

An Astronomy magazine tally has found that more than 100 of Earth's biggest research telescopes have closed in recent weeks due to the COVID-19 pandemic. What started as a trickle of closures in February and early March has become an almost complete shutdown of observational astronomy, and the closures are unlikely to end soon. Observatory directors say they could be offline for 3 – 6 months - or longer. In many cases, resuming operations will mean inventing new ways of working during a pandemic. That may not be possible for some instruments that require teams of technicians to maintain and operate. As a result, new astronomical discoveries are expected to come to a crawl. "If everybody in the world stops observing, then we have a gap in our data that you cannot recover," says astronomer Steven Janowiecki of the McDonald Observatory, Texas. "This will be a period that we in the astronomy community have no data on what happened."

These short-term losses are not astronomers' main concern. They are accustomed to losing telescope time to bad weather, and they are just as concerned as everyone else about the risks of coronavirus to their loved ones. So, for now, all that most astronomers can do is sit at home and wait for the storm to clear. "If we have our first bright super-nova in hundreds of years, that would be terrible," says astronomer John Mulchaey, of the Carnegie Observatories. "But except for really rare events like that, most of the science will be done next year. The universe is 13.7 billion years old. We can wait a few months." The prospects darken when considering the pandemic's long-term impacts on astronomy. Experts are already worried that lingering damage to the global economy could derail plans for the next decade of cutting-edge astronomical research. "Yes, there will be a loss of data for six months or so, but the economic impact may be more substantial in the long run," says Tony Beasley, director of the National Radio Astronomy Observatory. "It's going to be hard to build new telescopes as millions of people are out of work. I suspect the largest impact will be the financial nuclear winter that we're about to live through."

Through interviews and email exchanges with dozens of researchers, administrators, press officers and observatory directors, as well as reviewing a private list circulating among scientists, Astronomy magazine has confirmed more than 120 of Earth's largest telescopes are now closed as a result of COVID-19. Many of the shutdowns happened in late March, as astronomy-rich states like Arizona, Hawaii and California issued stay-at-home orders. Nine of the 10 largest optical telescopes in North America are now closed. In Chile, an epicentre of observing, the government placed the entire country under a strict lockdown, shuttering dozens of telescopes. Spain and Italy, two European nations with rich

astronomical communities - and a large number of COVID-19 infections - closed their observatories weeks ago.

Even many small telescopes have now closed, as all-out shutdowns were ordered on mountaintops ranging from Hawaii's Mauna Kea to the Chilean Atacama to the Spanish Canary Islands. Science historians say nothing like this has happened in the modern era of astronomy. Even during the chaos of World War II, telescopes kept observing. As wartime fears gripped Americans in the 1940s, German-born astronomer Walter Baade was placed under virtual house arrest. As a result, he famously declared Mount Wilson Observatory in California to be his official residence. With the lights of Los Angeles dimmed to avoid enemy bombs, Baade operated the world's largest telescope in isolation, making groundbreaking discoveries about the cosmos. Among them, Baade's work revealed multiple populations of stars, which led him to realize that the universe was twice as big as previously thought.

In the decades since, astronomers have built ever-larger telescopes to see fainter and farther-off objects. Instruments have become increasingly complex and specialized, often requiring them to be swapped out multiple times in a single night. Enormous telescope mirrors need regular maintenance. All of this means observatory crews sometimes require dozens of people, ranging from engineers and technicians to observers and astronomers. Most researchers also still physically travel to a telescope to observe, taking them to far-flung places. As a result, major observatories can be like small villages, complete with hotel-style accommodations, cooks and medics. Although observatories might be remote, few can safely operate during a pandemic. "Most of our telescopes still work in classical mode. We do have some remote options, but the large fraction of our astronomers still go to the telescopes," says Mulchaey, who also oversees Las Campanas Observatory in Chile and its Magellan Telescopes. "It's not as automated as you might think."

Some of the most complicated scientific instruments on Earth are the gravitational-wave detectors, which pick up almost imperceptible ripples in space-time created when two massive objects merge. In 2015, the first gravitational-wave detection opened up an entirely new way for astronomers to study the universe. Since then, astronomers have confirmed dozens of these events. The most well-known facilities, the twin Laser Interferometer Gravitational-wave Observatory (LIGO) - located in Washington state and Louisiana, both pandemic hot spots - closed on 27 March. Virgo, their Italian partner observatory, shut down the same day. (It is also located near the epicentre of that country's COVID-19 pandemic.)

More than 1,200 scientists from 18 countries are involved with LIGO. And no other instruments are sensitive enough to detect gravitational waves from colliding black holes and neutron stars like LIGO and Virgo can. Fortunately, the observatories were already near the end of the third observing run, which was set to end 30 April. "You don't know what you missed," says LIGO spokesperson Patrick Brady, an astrophysicist at the University of Wisconsin-Milwaukee. "We were detecting a binary black hole collision once a week. So, on average, we missed four. But we don't know how special they would have been." The gravitational-wave detectors will now undergo upgrades that will take them offline through at least late 2021 or early 2022. However, the pandemic has already delayed preliminary testing for their planned fourth run. It could prevent future work or even disrupt supply chains, Brady says. So, although it is still too early to know for sure, astronomy will likely have to wait a couple of years for new gravitational-wave discoveries.

Then there's the Event Horizon Telescope (EHT). Last year, the EHT collaboration released the first-ever image of a black hole. On 7 April, they published another unprecedented image that stares down a black hole's jet in a galaxy located some 5 billion light-years away. Now, EHT has cancelled its entire observing run for the year - it can only collect data in March and April - due to closures at its partner instruments.

Around the world, only a handful of large optical telescopes remain open. The Green Bank Observatory, Earth's largest steerable radio telescope, is still searching for extraterrestrial intelligence, observing everything from galaxies to gas clouds. The twin Pan-STARRS telescopes on the summit of Hawaii's Haleakala volcano are still scouting the sky for dangerous incoming asteroids. Both instruments can run without having multiple humans in the same building. "We are an essential service, funded by NASA, to help protect the Earth from (an) asteroid impact," says Ken Chambers, director of the Pan-STARRS Observatories in Hawaii. "We will continue that mission as long as we can do so without putting people or equipment at risk."

With observatory domes closed at the world's newest and best telescopes, a smattering of older, less high-tech instruments are now Earth's largest operating observatories. Sporting a relatively modest 6-meter mirror, the biggest optical telescope still working in the Eastern Hemisphere is Russia's 45-year-old Bolshoi Azimuthal Telescope in the Caucasus Mountains, a spokesperson there confirmed. For the foreseeable future, the largest optical telescope on the planet is now the 10-meter Hobby-Eberly Telescope (HET) at McDonald Observatory in rural West Texas. Astronomers managed to keep the nearly-25-year-old telescope open thanks to a special research exemption and drastic changes to their operating procedures. To reduce exposure, just one observer sits in HET's control room. One person turns things on. One person swaps instruments multiple times each night, as the telescope switches from observing exoplanets with its Habitable Zone Finder to studying dark energy using its now-poorly-named VIRUS spectrograph. Anyone who does not have to be on site now works from home. "We don't have the world's best observatory site. We're not on Mauna Kea or anything as spectacular," says Janowiecki, the HET's science operations manager. "We don't have any of the expensive adaptive optics. We don't even have a 2-axis telescope. That was [intended as] a massive cost savings." He added, "In this one rare instance, it's a strength." The supervising astronomer of HET now manages Earth's current largest telescope from a few old computer monitors he found in storage and set up on a foldout card table in his West Texas guest bedroom.

Like the Hobby-Eberly Telescope, the handful of remaining observatories run on skeleton crews or are entirely robotic. And all of the telescope managers interviewed for this story emphasised that even if they are open now, they will not be able to perform repairs if something breaks, making it unclear how long they could continue operating in the current environment. The Zwicky Transient Facility (ZTF) utilises the robotic, 48-inch Samual Oschin Telescope at Palomar Observatory in Southern California to produce nightly maps of the northern sky. Thanks to automation, it remains open. The so-called 'discovery engine' searches for new supernovas and other momentary events thanks to computers back at Caltech that compare each new map with the old ones. When the software finds something, it triggers an automatic alert to telescopes around the world. Last week, it sent out notifications on multiple potentially new supernovas.


The 48-inch Samual Oschin Telescope is the workhorse of the Zwicky Transient Facility at Palomar Observatory in Southern California. Palomar/Caltech

Similarly, the telescopes that make up the Catalina Sky Survey, based at Arizona's Mount Lemmon, are still searching the heavens for asteroids. In just the past week, they found more than 50 near-Earth asteroids - none of them dangerous. Another small group of robotic telescopes, the international Las Cumbres Observatory network, has likewise managed to stay open, albeit with fewer sites than before. In recent weeks, their telescopes have followed up on unexpected astronomical events ranging from asteroids to supernovas. "We are fortunate to still be keeping an eye on potential new discoveries," says Las Cumbres Observatory director Lisa Storrie-Lombardi.

However,, overall, there are just fewer telescopes available to catch and confirm new objects that appear in our night sky, which means fewer discoveries will be made. Chambers, the Pan-STARRS telescope director, says his team has been forced to do their own follow-ups as they find new asteroids and supernovas. "This will mean we make fewer discoveries, and that we will miss some objects that we would have found in normal times," he says.

Astronomer Cristina Thomas of Northern Arizona University studies asteroids. She was the last observer to use the 4.3-meter Lowell Discovery Telescope before it closed March 31 under Arizona's stay-at-home order. Thomas warns that, in the short term, graduate students could bear the brunt of the lost science. Veteran astronomers typically have a backlog of data just waiting for them to analyse. But PhD students are often starved for data they need to collect in order to graduate on time. "It's stressing them out in a way that it doesn't for me. We're used to building in a night or so for clouds," Thomas says. "If this goes on for months, this could put [graduate students] pretty far behind." One of Thomas' students was set to have observations collected for their dissertation by SOFIA, NASA's airborne observatory. However, the flying telescope is currently grounded in California, leaving it unclear when the students will be able to complete their research. Even when astronomy picks back up, everyone will be reapplying for telescope time.

The damage is not only limited to graduate students. An extended period of observatory downtime could also have an impact on Thomas' own research. Later this year, she's scheduled to observe Didymos, a binary asteroid that NASA plans to visit in 2021. Those observations are supposed to help chart the course of the mission. "The big question for us is: 'When are we going to be able to observe again?'" Thomas says. "If it's a few months, we'll be able to get back to normal. If it ends up being much longer, we're going to start missing major opportunities."


Keck Observatory telescopes, Hawaii Keck Obs.y/Andrew Richard Hara

The same qualities that brought observational astronomy to a standstill in the era of social distancing will also make it tough to turn the telescopes back on until the pandemic has completely passed. So, even after the stay-at-home orders lift, some observatories may not find it safe to resume regular operations. They will have to find new ways to work as a team in tight spaces. "We are just starting to think about these problems now ourselves," says Caltech Optical Observatories deputy director Andy Boden, who also helps allocate observing time on the Keck Observatory telescopes in Hawaii. "There are aspects of telescope operations that really do put people in shared spaces, and that's going to be a difficult problem to deal with as we come out of our current orders."

Astronomers say they are confident they can find solutions, but it will take time. Tony Beasley, the NRAO director, says his team is already working around a long list of what they're now calling "VSDs," or violation of social distancing problems. Their workarounds are typically finding ways to have one person do something that an entire team used to do. Beasley's research centre operates the Green Bank Telescope in West Virginia, as well as the Very Large Array in New Mexico and the global Very Long Baseline Array — all of which are still observing, thanks to remote operations and a reimagined workflow. Although the new workflow is not as efficient as it was in the past, so far there have not been any problems that couldn't be solved. However, Beasley says some work eventually may require the use of personal protective equipment for people who must work in the same room. However, he says they cannot ethically it while hospitals are in short supply.

Beasley and others think interesting and valuable lessons could still come out of the catastrophe. "There's always been kind of a sense that you had to be in the building, and you've got to stare the other people down in the meeting," he says. "In the space of a month, I think everyone is surprised at how effective they can be remotely. As we get better at this over the next six months or something, I think there will be parts where we won't go back to some of the work processes from before." Despite best efforts and optimistic outlooks, some things will remain outside astronomers' control. Right now, researchers are completing the 2020 Astronomy and Astrophysics Decadal Survey, a kind of scientific census. The guiding document sets priorities and recommends where money should be spent over the next 10 years. NASA and Congress take its recommendations to heart when deciding which projects get funded. Until recent weeks, the economy had been strong and astronomers had hoped for a decade of new robotic explorers, larger telescopes, and getting serious about defending Earth from asteroids.


Engineers prep NASA's Mars InSight lander for launch (Credit: NASA)

"Many of NASA's most important activities - from Mars exploration to studying extrasolar planets to understanding the cosmos - are centuries-long projects, the modern version of the construction of the great medieval cathedrals," Princeton University astrophysicist David Spergel last year as the process got underway. "The decadal surveys provide blueprints for constructing these cathedrals, and NASA science has thrived by being guided by these plans." However, many experts are predicting the COVID-19 pandemic will send the US into a recession; some economists say job losses could rival those seen during the Great Depression. If that happens, policymakers could cut the funding needed

to construct these cathedrals of modern science - even after a crisis has us calling on scientists to save society. By: Eric Betz

Cosmic visitor 'Oumuamua might have been ripped from an alien world 13 April: One of the weirdest objects ever discovered in our solar system — the alien space rock 'Oumuamua - is still sparking debates more than two years after its discovery. Most recently, the conversation has shifted to whether the cosmic visitor could be a fragment ripped from a larger world. In 2017, the Pan-STARRS asteroid-hunting telescope in Hawaii spotted an object moving at a breathtaking pace of 87 kilometres per second. Unlike most comets and asteroids before it, 'Oumuamua would only approach our Sun once before continuing its journey through space. This made it the first known interstellar object to have passed through our solar system. Scientists named the alien space rock 'Oumuamua, which roughly translates as 'messenger from afar arriving first' in Hawaiian. Although astronomers agree that 'Oumuamua visited our solar system from another star, that is where the agreement ends. Is it an alien asteroid, an alien comet, or an alien spaceship?


Artist's impression of the strange object 'Oumuamua. ESO/M. Kornmesser

Now, a pair of astronomers has used complex computer modelling to explain 'Oumuamua's combination of strange properties, finding the space rock may be a small shard ripped from a larger parent body. Their models suggest that when an object - anything from a comet to a super-Earth - passes too close to its star, intense tidal forces can cause heated fragments to slough off. These melted shards then refreeze, locking in their unique shapes. If these astronomers are right, then we should expect to spot plenty of oddly shaped worlds like 'Oumuamua in the coming years. "We anticipate many more interstellar visitors with similar traits to 'Oumuamua will be discovered by future observation," says study author Yun Zhang from the National Astronomical Observatories of the Chinese Academy of Sciences.


This shot of the interstellar comet Borisov, along with some background galaxies, was captured in November 2019. Its faint tail glows against the background stars. NSF's National Optical-Infrared Astronomy Research Laboratory/NSF/AURA/Gemini Obs.

Astronomers expected the first interstellar object they discover would be an alien comet. This is because comets orbit in the outskirts of star systems, and stars pass relatively near each other somewhat frequently. So, when two stars fly by each other, the gravitational interaction can rip comets from their loosely tethered orbits, flinging them out into space. This ejection mechanism was further supported last year when astronomers discovered the interstellar comet 21/Borisov which looks reassuringly like the 'dirty snowballs' found in our own solar system. It also exhibited a conventional cometary tail - the extended, fuzzy line of sublimated gas and ice that streams from comets as they approach the Sun.

However, ʻOumuamua left astronomers with more confusing hints about its nature and history. Instead of growing an icy tail, this alien space rock looked relatively dry. It also appeared surprisingly dense and rocky. Its shape was even more perplexing. Most space rocks in our solar system are shaped something like a potato - or, in the case of Arrokoth, like two of them smashed together. ʻOumuamua is long and stretched out, like a cigar.

Zhang and study co-author Douglas Lin from the University of California, Santa Cruz, set out to explain ʻOumuamua's weird properties. They simulated what would happen as an object flew extremely close to its home star. Their models showed that the tidal forces could literally shred it into long fragments before chucking them out into space. The researchers say that you can imagine planetary bodies as sand castles floating in space. Much like children on the beach moulding castles from many grains of sand, even modest worlds are built from many smaller pieces that are held together by gravity. When an outside force acting on a planetary grain grows stronger than the gravity binding it to the parent body, that smaller piece is yanked from the whole. This is what happens when an object ventures too close to a star. Astronomers previously saw the process unfold when comet Shoemaker-Levy 9 was ripped apart by Jupiter.

"The near and far parts of the planetary body are pulled apart from each other by the star's tidal forces, forming an elongated band of 'sand particles,'" Zhang says, extending the analogy. "At the same time, since the body is so close to the star, some of its surface melts and freezes after it flies away. This process glues the surface 'sand particles' together, and helps to form elongated fragments." According to the research, ʻOumuamua could very well be one such elongated fragment. The researchers are not the first to propose an idea like this, however. Previous modelling work published by astronomer Sean Raymond of Laboratoire d'Astrophysique de Bordeaux in Bordeaux, France, had already used computer models to show that ʻOumuamua could be a shredded chnunk of planetessimal created during the formation of a fledgling planetary system.

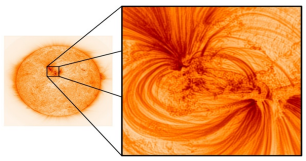

The Pan-STARRS Observatories watch for asteroids, supernovas and other transient objects from the island of Maui. Rob Ratkowski/Institute for Astronomy

Not everyone is convinced by the argument. Karen Meech, an astronomer at the University of Hawai'i who has studied ʻOumuamua but was not involved in this research, says she still believes the space rock has to be a comet. Part of why she thinks that is because one piece of evidence hinting that the space rock is an asteroid could simply be a dearth of observations. She points out that ʻOumuamua's high-speed trip through the solar system was too quick for astronomers to get a detailed look at the object. "Most of the observations of ʻOumuamua had to occur within a one-week period, and we simply did not have the ability to detect water," she says. "That isn't a lack of water. We just didn't have the sensitivity to see it."

There is another outstanding property these researchers have not explained yet, she says. ʻOumuamua's movement through our solar system implied it was being driven by more than just gravity - like a comet whose direction is slightly changed by the force of gases streaming off of it. "I think it absolutely is a comet," Meech says. "The non-gravitational

motion that our group detected was super strong, and there's no other way to maintain it except for outgassing. There's no other explanation." Because of 'Oumuamua's incredible speed, even the fastest spaceship humanity has ever built, NASA's Parker Solar Probe, could not catch it. As quickly as it came, the alien interloper was gone, never to be seen again. "We will never know for sure where 'Oumuamua came from or where it was created, and I've been very impressed with the models and the way people have tried to explain it," Meech says. "I don't think it proves anything." If Zhang and Lin are right, interstellar asteroids may be even more common than interstellar comets, the authors say. These alien asteroids would be relatively small and lack the comas of comets, which would make them much harder to detect while they are passing through our solar system. Future observations could help resolve the argument. By: Eric Betz

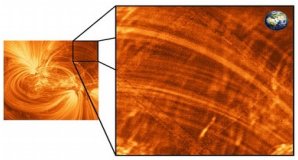
New images of the Sun reveal thin threads of million-degree plasma 15 April: The Sun's magnetic field constantly blasts particles from its surface into space. On Earth, we experience this steady stream of charged particles as the regular solar wind, which fuels aurorae. Our planet also must deal with the occasional fallout from strong outbursts during particularly powerful solar storms. However, for all of the downstream effects Earth experiences thanks to the Sun's magnetic field, the true nature of this enigmatic field remains one of Sun's most elusive mysteries. Now, new images are bringing scientists one step closer to understanding this important phenomenon by revealing, for the first time, the extremely fine details of our star's magnetic field - details too intricate to have previously been seen.


New images show delicate magnetic field lines, haloed by scalding plasma, sprouting from seemingly featureless regions of the Sun. University of Central Lancashire

The new close-up images were taken by NASA's High Resolution Coronal Imager, or Hi-C. They show never-before-seen bundles of delicate magnetic field lines threading across the Sun's atmosphere. These lines, which trace the magnetic field itself, are visible thanks to the particles of million-degree plasma trapped within. Each field line is only about 500 kilometres across, about the driving distance between Chicago and Cleveland. By capturing views of these previously invisible filaments, the researchers are now forced to reconsider what other features could be hiding in the regions of the Sun's atmosphere that appear dark or bland. Thanks to Hi-C's impressive resolution, astronomers have turned an unknown unknown into a known unknown.

Hi-C is not aboard a spacecraft; instead, it' i briefly carried aloft by a suborbital-flight rocket. Once in the air, the telescope is capable of zooming in on solar features just 43 miles (70 km) across, or just 0.01 percent the width of the entire Sun. That makes these photos of the Sun's atmosphere the highest-resolution versions ever taken. "Until now, solar astronomers have effectively been viewing our closest star in 'standard definition', whereas the exceptional quality of the data provided by the Hi-C telescope allows us to survey a patch of the Sun in 'ultra-high definition' for the first time," Robert Walsh, institution lead for the Hi-C team and an astrophysicist at the University of Central Lancashire in the UK, said. "Think of it like this: If you are watching a football match on television in standard definition, the football pitch looks green and uniform. Watch the same game in ultra-HD and the individual blades of grass can jump out at you - and that's

what we're able to see with the Hi-C images. We are catching sight of the constituent parts that make up the atmosphere of the star."


The inset view of this close-up reveals how the sizes of individual stellar plasma filaments compare to the size of Earth. University of Central Lancashire

Now that we have actually seen these delicate threads, the next step is to understand them. Researchers are not yet sure what generates these fine magnetic field lines. They also do not know how they affect observed things like the solar wind and coronal mass ejections, with the latter capable of pumping out billions of tons of material into space.Moving forward, the international Hi-C team is working to plan the telescope's next suborbital flight, where they hope to combine their observations with data taken simultaneously by the Parker Solar Probe and Solar Orbiter. By: Alison Klesman

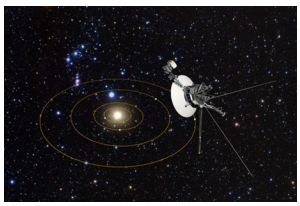
Hubble peers into a cosmic reef 24 April: On 24 April, NASA celebrated the 30th anniversary of the Hubble Space Telescope's launch with a star-studded image featuring NGC 2014 (right) and NGC 2020. These nebulae are part of a much larger star-forming complex located in the Large Magellanic Cloud. The structure is often called the Cosmic Reef, in part for NGC 2014's intricate, coral-like appearance.


NGC 2014 (right) and NGC 2020 are part of a larger star-forming complex in the the Large Magellanic Cloud. NASA, ESA, and STScI

Within the colourful region is a bright group of young stars, each 10 times the mass of our Sun or more. These massive stars are blasting away the gas and dust from which they formed, carving away their birth nebula. The region's reddish colour comes from glowing hydrogen and nitrogen gas, while bluer colours show oxygen gas energized by the stars' ultraviolet light. Nearby, blue-hued NGC 2020 is generated by a single Wolf-Rayet star 15 times more massive than the Sun and 200,000 times as luminous. NGC 2020's colour also comes from oxygen gas, which has been blown away from the central star and heated to roughly 11,000 degrees Celsius. Hubble has made invaluable contributions to science and outreach, engaging scientists and the public alike with breathtaking views of our universe. Its scientific contributions include 1.4 million astronomical observations to date, with many more to come. NASA expects the telescope to remain operational through at least 2025, and its orbit will remain stable until the 2030s. By: Alison Klesman

Voyager: What's next for NASA's interstellar probes? 28 April: Thousands of years from now, Voyager 1 and Voyager 2 will leave our solar system, but their instruments will stop working long before that happens. In 1977, NASA launched the twin Voyager spacecraft to probe the outer reaches of our solar system. The space agency was still in its infancy then. However, with the triumph of the Apollo Moon landings just five years behind them, NASA was ready to dive headfirst into another bold idea. Thanks to a rare alignment of the solar system's four outer planets - which happens just once every 175

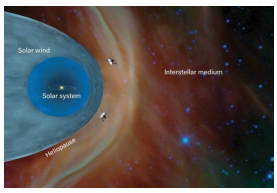
years - the agency had the chance to redefine astronomy by exploring Jupiter, Saturn, Uranus and Neptune in one fell swoop. At Jupiter, the probes surprised scientists when they spotted volcanoes on the moon Io and discovered Europa is likely an ocean world. Saturn surrendered its atmospheric composition and new rings, and Voyager 2 returned humanity's only close-up looks at Uranus and Neptune. To this day, scientists are still making new discoveries by exploring Voyager's decades-old data.


Voyager 2, looking back. NASA/ESA/G. Bacon/STScI

These probes have not stopped scouting the outer solar system. Voyager 1 and Voyager 2 are still functioning today, making them the longest-running and most-distant space mission in history. Though they are each taking different paths, both spacecraft are still screaming their way out of the solar system, and they still have a long way to go.

The two Voyager spacecraft took different paths through the solar system, and both have since left the sun's influence entirely. NASA/JPL-Caltech

Even travelling at 56,000 kph, the Voyager probes will need another 300 years just to reach the inner edge of the Oort Cloud - a large sphere of icy space rocks that begins a couple of thousand times farther from the Sun than Earth. The outer edge of the Oort Cloud may be so distant that it take the Voyager probes 30,000 years or more to completely cross it, according to NASA. After that, in about 40,000 years, Voyager 1 could finally approach another star. Voyager 2, however, will need 300,000 years before it comes close to bathing in the light of another star.



Only the Voyager probes have passed the heliopause, leaving the sun's influence. New probes may one day study the interstellar medium lying beyond. NASA-JPL/Caltech

Back in 2012, Voyager 1 became the first spacecraft to reach interstellar space. There are no road signs letting NASA know that the craft broke the barrier. Instead, they determined it thanks to measurable changes Voyager 1 detected when it hit a region called the heliopause. Our Sun produces an intense stream of particles, dubbed the solar wind, that flows outward in all directions and creates a magnetic field that shields the planets from interstellar particles. The powerful wind carves a huge cavity in the interstellar medium (the region between stars) that encapsulates all the planets. This protective bubble is called the heliosphere, and the heliopause is its outer boundary - where our Sun's influence is finally overpowered by distant activity like erupting supernovas.

Scientists were surprised when Voyager 1 measured the magnetic field just inside and just

outside of the heliopause, finding no significant changes in its overall direction. Then, when Voyager 2 reached this same boundary of interstellar space in 2018, it found similar results. Voyager 2 offered up another surprise when NASA scientists released its first results from beyond the heliopause. They had originally expected that particles from our sun would not 'leak out' of the heliosphere into interstellar space. Voyager 1 saw no such leakage, but Voyager 2 found the opposite. It recorded a small trickle of solar particles streaming through the heliopause. In recent years, the probes also have discovered that the solar wind moves more slowly at our solar system's edge than expected. All said, by studying data from the twin probes, astronomers have been able to compare, contrast and confirm results about the boundary separating our solar system from interstellar space.

Since their launch more than 40 years ago, NASA has remained in near-constant contact with the Voyager probes. However, the space agency has temporarily stopped receiving messages from Voyager 2 while they work to repair and update one of the three Deep Space Network antennas used to communicate with the probes, the New York Times reported in March. It is a risky move, and there is a chance we may not hear from Voyager 2 once the receivers are turned back on. However, Earth is still in contact with Voyager 1 and the discoveries have not ended quite yet. Mission planners intend to keep communicating with the spacecraft until they fail or lose power. Both should be able to keep at least one scientific instrument running until 2025. Even after that, NASA expects to continue receiving engineering data from the probes until 2035, when they exceed the range of the Deep Space Network antennas. By: Eric Betz

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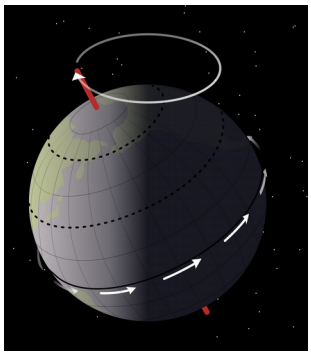
DID YOU KNOW?

Zodiac constellations 3 – Zodiac: precession of the equinoxes

Ptolemy

In contrast to the Babylonians, The Greek astronomer Ptolemy (305-30 BCE) clearly and correctly explained the theoretical basis of the zodiac as being a tropical co-ordinate system by which the zodiac is aligned to the equinoxes and solstices rather than the visible constellations that bear the same names as the signs. His definition was based on new understanding of the so-called precession of the equinoxes, which had been discovered around 130 BCE by Hipparchus. This explains why the zodiacal area and their originally corresponding constellations no longer overlap. It also explains why mean the time of year the Sun is in a given constellations has changed since Babylonian times.

Precession of the equinoxes is the motion of equinoxes along the ecliptic, over time. It arises from the combined motion of the equator (lunisolar precession) and the ecliptic (planetary precession). Lunisolar precession is the effect of gravitational attraction of the Sun and the Moon on Earth's equatorial bulge. It causes Earth's poles to sweep out a circle on the sky around the pole of ecliptic. Planetary precession involves perturbation of Earth's orbital plane by the attraction of the planets on Earth's centre of mass.
It causes the equinox to move east along the celestial equator ie opposite direction of lunisolar precession. This effect is much smaller than that of lunisolar precession, so overall the direction of movement is westward.



Earth's spinning wobble

Precession of the equinoxes is, thus, the combined effect of gravitational attraction of the Sun, Moon and planets. Like the wobbling motion of a spinning top or gyroscope during which the axis of rotation gradually sweeps out a conical shape, the spinning Earth undergoes a slow precession, taking about 25,800 yrs to describe one complete circle on celestial sphere. The equinoxes make one circuit of ecliptic in the same time. The circle radius is approx 23.5 degrees ie the inclination of Earth's axis. The result of precession is that right ascension (longitude) and declination (latitude) of stars change over time. The equinoxes move westwards on the celestial sphere by 1° in about 72 years.

Precession of the equinoxes means that, although the first degree of Aries is nominally the start of the system at the March equinox, this point is actually presently near the end of Pisces constellation, having been within Pisces since the 2nd century CE.

Around 2,000 years ago, when the ancient Greeks named the zodiacal signs, the location of their eponymous constellations occupied the same position on the celestial sphere. As a result of precession, however, these constellations have drifted and moved east by over 30° and no longer coincide with the signs. Also, because the constellations take up varying widths of the ecliptic eg Virgo takes up 5x the amount of ecliptic longitude than Scorpius, the Sun is not in each constellation for same amount of time.

Zodiac signs have never been used to determine the boundaries of astronomical constellations fully or partly within the zodiac because of their differing sizes and shapes. However, use of the zodiac to determine astronomical measurements was the main method for finding celestial potions in western astronomy continued for centuries. The convention of measuring celestial longitude within individual signs was used until the mid 19th century. Modern astronomy numbers degrees of celestial longitude from 0 -360 deg, rather than 0 – 30 within a zodiac sign. This is part of the equatorial co-ordinate system measures astronomical positions by right ascension and declination rather than ecliptic based definitions of celestial longitude and latitude.

Sources: Ridpath, I (Ed) 2012 Oxford dictionary or astronomy Oxford, OUP, Ridpath, I (Ed) 2006 Astronomy London, Dorling Kinderslety, en.wikipedia.org

For more information on the Hermanus Astronomy Centre and its activities, vvisit our website at www.hermanusastronomy.co.za

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