

"The Southern Cross"



HERMANUS ASTRONOMY CENTRE NEWSLETTER

FEBRUARY 2019

Monthly meeting The Annual **general Meeting** will place on **Monday 18 February** at the **Catholic Church Hall** starting at **19.00**.

Membership renewal for 2019

There will be a small increase in the fees for 2019, following 2 years at the current rate.

The 2019 fees are as follows:

Member: R160

Member's spouse/partner/child, student: R80

New members joining after 1 October 2018 will have membership until the end of 2019.

Payment can be made in cash (at meetings directly to the Treasurer), or via online transfer. The Standard Bank details, for the latter, are as follows:

Account name – Hermanus Astronomy Centre

Account number – 185 562 531

Branch code – 051001

If you make an online donation, please reference your name and 'subs' or 'membership', or it is not possible to attribute the payment to you.

2019 monthly meeting dates Remaining meeting dates are 18 Feb, 18 Mar, 15 Apr, 20 May, 24 Jun, 15 Jul, 19 Aug, 16 Sept, 21 Oct, 18 Nov and 9 Dec. The provisional list of topics and speakers is detailed below.

WHAT'S UP?

Alpha Centaurid meteor shower This annual meteor shower peaks in February and, this year is a good one for observing the phenomenon. It lasts from 28 January to 21 February, reaching maximum on 7 February. It is visible from 22.00 – 03.30 towards the south-east in the region of the Pointer furthest away from the Southern Cross ((Alpha) α Centauri). The showers are caused by meteoroids entering Earth's atmosphere on parallel trajectories, at very high speeds. Because all the particles are travelling parallel to each other at the same velocity, they appear, from an observer's perspective, to radiate from a single point, the radiant. Meteor showers are almost always named for the constellation from which they appear to originate. The showers are the result of interaction between Earth's atmosphere and streams of debris from a comet as Earth passes through the

debris field on its annual solar orbit. The debris forming showers is usually tiny, smaller than a grain of sand, and burns up in the upper atmosphere.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the meeting held on 21 January, Dr Amanda Sickafoose, Head of Instrumentation at the SAAO in Cape Town talked on 'Recent results from the outer solar system'. An outstanding speaker, Amanda again gave a fascinating and informative presentation. In addition to giving an update on the material she presented at her last talk to HAC, in 2017, it was also fascinating to learn of more recent findings on other small, but intriguing objects observed beyond Jupiter's orbit. Amanda and her colleagues use stellar occultation (the passage of a distant object in front of a distant star) to identify the characteristics of known or anticipated objects by analysing the characteristics of the light curves which their observations produce.

Work on the Centaur Chiron has added to earlier findings, confirming the presence of a ring system. The origin of this and other rings around Centaurs is still not known. It is hoped that continuing study of the data may provide information on the ring characteristics including particle size. The other three objects she talked about are more distant Trans-Neptunian Objects (TNOs). Work has also continued on Orcus and its satellite Vanth. Although much still needs to be discovered about these eg Orcus is thought to be quite large, but more information about its size is still being sought, it has been found that the two objects, unusually, have different surface colours, one reddish, the other grey. Data on Vanth from recent occultation data has confirmed the absence of an atmosphere, but its size is still not confirmed. More data on larger Orcus will, hopefully, be obtained from future occultations

Occultation data on Pluto has both confirmed and been supplemented by data obtained by the 2015 flyby by the New Horizons spacecraft. Researchers are focussing particularly on the nature and dynamics of Pluto's atmosphere (which has been found to vary in density over time), and seasonal effects on the dwarf planet's surface ice. There has been speculation that Pluto may be losing its atmosphere, but data from four occultation events during 2017 and 2018 have confirmed that it is still present. The final object which Amanda talked about was very topical: MU69, now named Ultima Thule. Images of this very, very distant object taken by New Horizons early in January confirmed data already obtained from occultations studied to aid the mission team in locating the object. The data had also predicted the 'snowman' shape which New Horizon's confirmed, although it was the latter which showed its surface to be red. UM69 seems to be an example of a contact binary, an object formed of two objects which collided softly enough to stick together rather than breaking each other up.

Interest groups

Cosmology No meeting was held in January

Astro-photography The meeting scheduled for January was cancelled.

Other activities

Educational outreach

Hawston Secondary School Space Cadets No meetings took place during January.

Lukhanyo Youth Club The first meeting of the year took place on 31 January. There are currently 13 cadets, from Grades 9 – 12.

Stargazing No event took place during January.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's meeting, will take place on **Monday 18 February** at the **Catholic Hall** starting **19.00**. It will be the **Annual General Meeting**. The agenda and minutes of last year's meeting have been circulated to members.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting is on **Monday 4 February** at the **Catholic Hall**, starting at **19.00**. Pierre Hugo will lead the sixth session in the series 'Natural philosophy: science for the non-scientist'.

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 will be no meeting in February. The next meeting is scheduled for **11 March**.

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 The next meeting is scheduled for **Friday 1 February** at **Gearing's Point**, weather permitting. The decision on whether the event will take place will be circulated to members on the day.

FUTURE TRIPS

Planning is underway for an outing 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**.

18 February	AGM
18 March	Topic TBA. Presenter: Case Rijdsdijk, President of ASSA
15 April	'Another one bites the dust'. Presenter. Dr Shazrene Mohaned, SAAO, CT
20 May	'The upgraded HESS facility'. Presenter, Herbert Pioller, Centre member
24 June	'Star formation and the gas cycle in galaxies'. Presenter: Dr Moses Mogotsi, SAAO., CT
15 July	'Near-Earth asteroids: monitoring close approaches and mitigating objects'. Presenter: Dr Nicolaus 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	TBA

18 November 'The Cassini family dynasty and their Saturnian legacy'. Presenter:
Jenny Morris, centre member
9 December Xmas party

ASTRONOMY EDUCATION CENTRE AND AMPHITHEATRE (AECA)

A decision by the Council of Overstrand Municipality on the planning application continues to be awaited. In the meantime, the Friends of the Observatory pledge fund continues to be an important source of funds to cover associated costs.

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, something which is still awaited.

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:

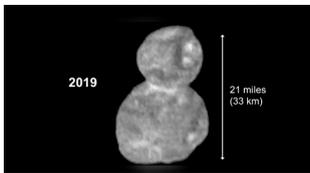
Account name – Hermanus Astronomy Centre
Account number – 185 562 531
Branch code – 051001

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

ASTRONOMY NEWS

New Horizons' first close-up pictures of Ultima Thule reveal a binary world 2

January: NASA's New Horizons' team has released the first close-up images from Ultima Thule. Even at the speed of light, signals from the outer solar system take a long time to reach Earth; however, the pictures were well worth the wait. They reveal Ultima Thule is actually two objects stuck together. That is prompted them to dub the big lobe "Ultima" and the small one "Thule".

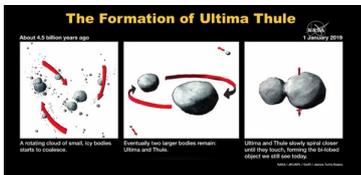


Scientists say Ultima Thule is actually two objects stuck together. They've dubbed the big one "Ultima" and the small one "Thule." NASA/JHUAPL

While the first images may be a bit disappointing, the best pictures will be arriving in the days and weeks ahead. "We have far less than one percent of the data that's stored on [New Horizons]," spacecraft lead Alan Stern of the Southwest Research Institute said at a press conference Wednesday.

As billions of people across the world ushered in the new year, the New Horizons spacecraft whizzed by a far-flung space rock named Ultima Thule, making it the most distant object ever visited by humanity. Travelling at a speed of nearly 14.5 km per second, New Horizons' did not take long to zip past Ultima Thule, which is only about 30 km long and 15 km wide. During its closest approach, on 1 January, New Horizons passed within just 3,500 km of the mysterious bowling-pin-shaped rock, collecting data all the

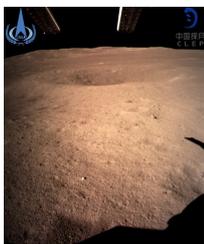
while. Within just 10 hours, the spacecraft successfully 'phoned home', confirming to NASA scientists that it had survived its close encounter with the distant object. "We have a healthy spacecraft," announced Alice Bowman, Mission Operations Manager for New Horizons, to a cheering crowd. Since New Horizons sent its first post-flyby message, the mission team slowly but surely has been receiving a trickle of data on Ultima Thule (pronounced TOOL-ee, a Latin phrase meaning "a place beyond the known world"), which is located a staggering 6.6 billion km from Earth.



New Horizons scientists have spent the past day trying to figure out how the object formed. NASA/JHUAPL

Ultima Thule is tiny, icy body known as a Kuiper Belt Object (KBO). KBOs are a distinct class of solar system objects that lie far beyond the orbits of Neptune and Pluto. Although over a thousand KBOs already have been discovered (including the most famous KBO, Pluto), Ultima Thule was not found until 2014. Because Ultima Thule is so small and distant, it is very hard for researchers to tease out many of its attributes, even with the most advanced telescopes available today. But from early on, astronomers figured the small body was likely made of dirty ice and rock. Early observations of Ultima Thule taken by New Horizons suggested that the rock is rather elongated and shaped somewhat like a bowling pin. Today's imagery reveal that the world is actually two objects which were stuck together in a slow cosmic collision. By: Jake Parks

China's Chang'e-4 mission lands on Moon's far side, snaps first image 3 January: For the first time in history, a spacecraft has landed on the far side of the Moon. At 10:26 am, on 3 January, Beijing time, China's Chang'e-4 spacecraft made a successful soft landing in the Von Kármán crater within the Moon's South Pole-Aitken (SPA) basin. A few hours after the landing, the craft sent back its first close shot of the far side of the lunar surface via the relay communication satellite Queqiao, according to the state-run China Global Television Network.



The Chang'e-4 spacecraft sent back the world's first close shot of moon's far side after making a historic soft landing. CNSA

The Chang'e-4 mission took off for the Moon just over a month ago, and reached orbit around the satellite on 12 December. The mission harboured some risk, because operators on Earth cannot directly communicate with spacecraft on the Moon's far side. Chang'e-4 communicates with Earth via a relay satellite in orbit around the Moon, something that adds another level of complexity and risk, according to Jim Head, a researcher at Brown University who worked with Chinese colleagues to analyse Chang'e-4's landing site. The landing appears to have been accomplished without any major issues, however, and the

Chinese lander and rover will be able to begin exploring the moon's far side, an environment astronauts and spacecraft have until today only seen from afar.

The far side of the Moon, because it faces away from Earth, is not polluted by radio 'noise' from our planet. So scientists think that it could be an ideal location for radio astronomy, which works best when there are no interfering signals like we have on Earth. The spacecraft's spectrometer, which will make radio astronomy observations, will test this idea. Another instrument on board the spacecraft, the Advanced Small Analyser for Neutrals (ASAN), will measure how solar wind - a flow of charged particles from the Sun - interacts with the lunar surface. The first data from this instrument is expected to be available before 11 February. The spacecraft also carries cameras and a radiation experiment.

By: Chelsea Gohd

Repeating fast radio burst detected for second time in history 9 January: For just the second time, scientists have recorded the repeat of a mysterious cosmic flash known as a fast radio burst (FRB). This remarkable observation could help scientists to better understand this phenomenon and where these bursts originate in the universe.



Artistic visualization of a neutron star, which is one of the possible sources for FRBs. L. Calçada/ESO

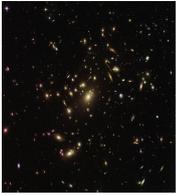
FRBs are extremely brief (think millisecond) flashes of radio waves that originate from random (as far as we can tell) places in the cosmos. Astronomers have grappled with this mystery for years because, while they continue to observe bursts, they are still unsure of what causes them. "We estimate that there are up to 1,000 of these bursts in the entire sky every day," corresponding author Shriharsh Tendulkar of McGill University said. However, until this most recent work, only one repeating FRB, known as FRB 121102, had been observed. Every other FRB has flashed once and then disappeared. Now, using the Canadian Hydrogen Intensity Mapping Experiment (CHIME) instrument, researchers have detected a second such repeating event. Excitingly, it bears striking similarities to the first repeating FRB.

This repeating FRB is one of thirteen (the rest are single bursts) announced today by scientists. "These are extremely powerful and frequent bursts. We have never seen anything like this before. The closest analogues we have in our own galaxies (pulsars) are more than a trillion times fainter," Tendulkar said about the repeating FRB. Additionally, "this second source shows burst behaviour (i.e. multiple structures in the burst) that is extremely similar to the first repeating FRB and which is different from all the single FRBs," Tendulkar said.

The new repeating FRB has another unusual characteristic, as well. While most other FRBs detected were recorded at between 1400 megahertz (MHz) and 2000 MHz, these bursts were found at 400-800 MHz, far lower than ever before. "Now we know that FRBs are detectable at 400 MHz, and should be detectable at even lower frequencies," Tendulkar said. 400 MHz is the lower limit of the CHIME experiment at the moment, so other FRBs at lower frequencies could simply be going undetected.

By: Chelsea Gohd

A third of all galaxy clusters have gone unnoticed until now 14 January: The universe is far from homogeneous. Rather, stars, and the galaxies that contain them, clump together in some places, brought together by their shared gravitational attraction. Astronomers have historically found clusters of galaxies in the sky to be relatively easy to spot, as they are extremely large and bright. However, a new study suggests that a third of all galaxy clusters have been hiding undiscovered out in the cosmos.



The galaxy cluster Abell 370, Hubble Space Telescope. ESA/Hubble/NASA

Scientists estimate that very little of the mass of a galaxy cluster is actually made of galaxies themselves. Much of the mass probably comes from the hot gas that floats between the galaxies, and far more is probably from dark matter. This means that the most obvious feature of a galaxy cluster is actually responsible for very little of its mass. It is a disparity that has likely hidden an enormous number of less traditional galaxy clusters throughout the universe.

It might seem strange to think that such a large percentage of galaxy clusters have gone unnoticed. However, as Roger Clowes of the Jeremiah Horrocks Institute at the University of Central Lancashire, said, "the first clusters to be discovered were visually quite obvious in photographic images of the sky." Since galaxy clusters have always been thought of as extremely bright, these traditional clusters have been easy to spot with simple imagery. In this new study, the team tried to avoid the assumption that all or most clusters are this way, Clowes said. "As a result, we find these new clusters, for which less-bright spiral galaxies and irregular galaxies are more prevalent and there is less concentration of galaxies towards the centres of the clusters," he added.

This research team used public data from 191,440 galaxies. To assist their search, they added another dimension to their analysis: an object's redshift. That is a phenomenon in which light is shifted towards the red end of the visible light spectrum as an object moves in the opposite direction as us. This helped them to locate galaxy clusters that aren't visibly obvious. In addition to this approach, the team used a specialised computational algorithm designed to pick out clusters of galaxies that avoided traditional methods of picking out galaxy clusters like brightness and looked only at how they were distributed.

The study yielded the incredible result that a third of all galaxy clusters have been hidden until now. This work also revealed some characteristics of these newly-found clusters. "The new clusters are less luminous, richer in spiral galaxies and irregular galaxies, and less concentrated towards the centres," Clowes said, adding that "Of course, we find the conventional clusters, but we find something new too!"
By: Chelsea Gohd

Saturn's rings are surprisingly young 17 January: During NASA's Cassini spacecraft's grand finale, the craft dove between the planet and its rings. In doing so, it collected new insights into the ringed planet, including the surprising age of Saturn's rings. According to a new study, scientists have found that the rings are much younger than the planet itself, most likely formed in the last 100 million years.



Researchers have found that Saturn's rings are actually much younger than the planet itself. NASA/JPL-Caltech/SSI

Before swooping in between the planet and its rings, Cassini orbited the planet outside of its rings. That made it hard to separate the gravitational effect of the rings from the gravity of the planet and, in the process, find the rings' mass. Scientists have suggested that the mass of Saturn's rings is directly linked to their age, so that answer had to wait until Cassini's final days.

As the craft dove between Saturn and its rings, researchers monitored a radio link between the spacecraft and Earth. This allowed the team to accurately measure the gravitational field around the planet without the gravitational effect of the rings getting in the way, according to Luciano Iess of the Sapienza University of Rome. After finding that the rings have a fairly low mass, they came to the conclusion that the planet's rings are only 10 to 100 million years old. This is much younger than the planet itself, which is estimated to be 4.5 billion years old. "There were already clues from Voyager and Cassini measurements that the rings had not formed with Saturn," Iess said. "But now we have much more concrete evidence, which was only possible to obtain during the final phase of the mission."

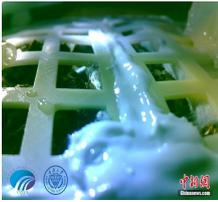
While these results reveal the age of Saturn's rings, they do not explain how or why the rings formed so recently. "A catastrophic event like a collision looks to me the most obvious explanation, but there may be problems with that too," Iess said. "The origin of the rings has to be put in the broader context of the dynamics of the Saturnian system. There are colleagues who think that even the inner moons of Saturn are young, and they are migrating inward."

In addition to revealing the age of Saturn's rings, the gravity measurements taken during Cassini's close passes allowed the team to uncover more information about the planet's gaseous interior structure. Saturn, which is mostly made up of hydrogen and helium, has an interesting atmosphere. The outer layers of its atmosphere rotate faster than its inner layers. Using this new data, the team determined how much faster the outer layers rotate than the inner layers. They also found that the planet begins to rotate uniformly at a depth of about 9,000 to 10,000 km. The study also revealed the size of Saturn's core. Made up of heavy elements, the team found that the planet's core is about 15 to 18 Earth masses, or 15% of the total mass of the planet. According to Iess, this finding could allow researchers to better understand how the planet and its moons formed.

By: Chelsea Gohd

The plants that China sprouted on the Moon have died 18 January: Earlier this month, an experiment on China's Chang'e 4 lander got cotton plants to sprout on the Moon, a historic first. Well, they are already dead. On 7 January, China's space agency released pictures of cotton seeds beginning to grow on the Chang'e 4 lander. However,, the new sprouts have not survived the freezing temperatures on the lunar surface, even in their protective capsule. The cotton seeds sprouted inside a container as part of the lunar

mini-biosphere experiment aboard the lander. Just over a week later, or some 213 hours, the experiment is over.



Cotton plants budding in the Chang'e-4 mini biosphere experiment on the mission's lunar lander on January 7. Chongqing University/CNS

The seeds of other plants like potato, Arabidopsis, and rapeseed, as well as fruit-fly eggs and yeast were also placed within the experiment's 3 kg canister. With controlled humidity, air, water, and nutrients, this container was specifically designed to keep these organisms alive. However, the lunar surface is an extreme place for any living thing to grow. From the low gravity to the high radiation levels and extreme temperatures that can swing wildly from about -233°C at night to 123°C in the daytime, it is not easy for Earth organisms to survive on the lunar surface. That was made apparent when the cotton seeds in the experiment became the first plants to sprout on the lunar surface and then quickly perished.

The cotton plant's demise was caused by the freezing temperatures that washed over as day turned to night time on the Moon. Since the Moon takes about 27 Earth days to rotate, day and night each last about two weeks. The experiment ran on solar power and did not carry a battery because it would have been too heavy. So, once night fell, the power went out. The canister containing the young cotton plants reached a temperature of around -50°C , said Liu Hanlong, who led the experiment at Chongqing University. After the two-week-long night time ends on the Moon and day breaks, the dead cotton buds will rot within their capsule.

By: Chelsea Gohd

Astronomers may have finally connected supernovae and gamma ray bursts 21

January: The link between gamma ray bursts (GRBs) and supernovae has been a confusing one. GRBs are highly energetic jets that blast from massive star explosions, but not all powerful supernovae produce them. During a recent study of a distant GRB, researchers saw a 'cocoon' of energy surrounding it. They believe that GRBs create these cocoons by transferring energy to them, and if they transfer too much, they become too weak to shine through the star and become visible. These findings could explain why powerful supernovae do not always produce GRBs.

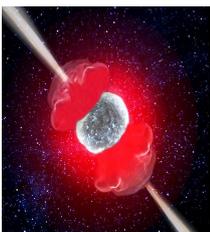


Illustration of gamma rays bursts and their surrounding "cocoon" blasting from a hypernova. Anna Serena Esposito

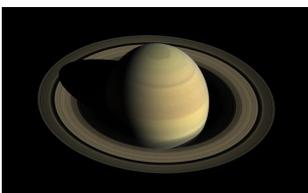
At the end of their lives, low mass stars like the Sun will quietly fade into darkness, while a higher mass stars will explode in a turbulent supernova. However, enormous stars, which are more than 25 times the mass of the Sun, are thought to explode in a hypernova

- which shines 10 times brighter than a supernova and leaves a black hole or neutron star in its wake. It is believed that GRBs emit almost exclusively from these hypernovae, yet astronomers have seen several that do not produce GRBs at all. Until recently, their absence has stumped researchers.

Back in December 2017, a team of researchers spotted a GRB shining from a galaxy 500 million light years away. They quickly traced the burst back to an early-stage hypernova. Here, the star had already collapsed into either a black hole or neutron star, but hadn't ejected its outer layers and exploded yet. The GRB, which usually outshines the entire hypernova, was strangely dim. Because of this, they were able to home in on the event. They observed the hypernova with the Gran Telescopio Canarias in Spain, and noticed something peculiar - a 'cocoon' of high energy, rapidly expanding particles surrounding the GRB. The team used the telescope to measure the object's chemical composition, and found that it emitted more energy than the GRB itself. This led researchers to believe that, as it travelled through the star, the GRB created the cocoon by transferring immense amounts of energy to it. If it had transferred too much, it would not have had enough energy to shine through the star's outer layers and become visible. If these cocoons are created in all hypernovae, they could explain why some produce GRBs and some do not.

"This work has allowed us to find the missing link between these two types of hypernova through the detection of an additional component: A sort of hot cocoon generated around the jet, as it propagates through the outer layers of the progenitor star," said Luca Izzo of the Institute of Astrophysics of Andalusia in Spain. By: Amber Jorgenson

What time is it on Saturn? We finally know 22 January: For years, the length of a day on Saturn has remained an unsolved puzzle to frustrated astronomers. Now, a graduate student from the University of California Santa Cruz believes that he has finally solved the mystery. Christopher Mankovich used the planet's rings to determine that a day on Saturn lasts for 10 hours, 33 minutes, and 38 seconds.



Using a new strategy, one researcher believes that he has solved the longstanding mystery of the length of a day on Saturn. NASA/JPL-Caltech/Space Science Institute

Being a gas giant, Saturn has no solid surface that researchers can track in order to time the planet's rotation. Because of this, it has been tricky for them to figure out when a day starts and ends. For Jupiter, another gas giant in our solar system, scientists figured out the length of a day using the planet's radio emissions. However, Saturn's strange magnetic field means that the same measures used on Jupiter could not be used.

Mankovich's estimate - 10:33:38 - is faster than previous estimates from 1981 made with radio signals from NASA's Voyager spacecraft that suggested a day on Saturn to be 10:39:23. This discrepancy is likely because Saturn's magnetic field is almost perfectly aligned with its rotational axis - unlike Jupiter. "Our approach was new in that we applied seismology - literally, the study of the way things shake - to get at the length of a Saturn day," Mankovich said. Using data captured by NASA's Cassini spacecraft, Mankovich found that wave patterns within Saturn's rings are the result of ring particles feeling 'extra tugs'

from the planet's gravitational field. "These extra tugs in Saturn's gravity field come from the planet itself oscillating," Mankovich said. "Just like the properties of earthquakes teach us about the inner structure of the Earth, the precise frequencies of the ring waves caused by Saturn's oscillations give us a handle on the inner workings of Saturn, including its rotation."

By tracing Saturn's seismic activity through wave patterns in its rings, Mankovich was able to find that Saturn's interior vibrates at frequencies that cause variations in the planet's gravitational field. Particles in the planet's rings then pick up on those variations. These findings allowed Mankovich to develop models of Saturn's internal structure that match the rings' waves. With these models, he was able to track the movement of Saturn's interior and, therefore, the rotation rate and length of a day.

The results came as rather a surprise even to Mankovich. "For giant planets, the real burning questions that astronomers have are mostly about how these planets form, and to answer those questions we want to understand things like whether Jupiter and Saturn have discrete, dense cores versus more complicated, mixed-up interior structures," Mankovich said. "So as we got into the interpretation of these ring waves, what I absolutely didn't expect was that the majority of the ring waves that we were able to explain told us quite a lot about the rotation, and actually very little about these open questions regarding the deep structure inside Saturn. Now we've shown that these waves are extremely valuable for zeroing in on the length of a Saturnian day, and so from that perspective, it's advantageous that most of the waves aren't terribly sensitive to these open questions regarding the deep interior, which would have muddled their interpretation".

By: Chelsea Gohd

New Horizons' latest images from Ultima Thule reveal new details 25 January:

Just after midnight on New Year's Day, NASA's New Horizon's spacecraft flew past the Kuiper Belt object, 2014 MU69, more commonly known as Ultima Thule. Now, the best image of the object to-date has reached Earth, revealing previously unseen details on the peanut-shaped space rock.



The latest image of Kuiper Belt Object 2014 MU69. (Credit: NASA/JHUAPL/SwRI)

This latest image was taken with the wide-angle Multicolor Visible Imaging Camera (MVIC) component of the spacecraft's Ralph instrument. The camera snapped the shot when the spacecraft was just 6,700 km from the object. The image had an original resolution of 135m per pixel. After beaming back to Earth between around 18 January, scientists enhanced the details of the image to make it as clear and sharp as possible, though, this process (known as deconvolution) will make the image look a bit grainier at high contrast.

The new image shows Ultima Thule's surface along the day/night boundary near the top of the object. You can also make out a number of small pits on the surface, which stretch nearly a kilometre across. You may notice a large, circular feature on the space rock's smaller half. Using this image, it appears as though this feature, which stretches about 7

km across, is a depression. It is too early to definitively say whether these features are impact craters or created from internal processes. Both halves, or lobes, of the object also have light and dark patterns. The most obvious of these is the light band that separates the object's two lobes. Scientists do not yet know where these patterns came from, but according to a statement from Johns Hopkins Applied Physics Laboratory, they could help researchers to decipher the object's origins and how it formed. "This new image is starting to reveal differences in the geologic character of the two lobes of Ultima Thule, and is presenting us with new mysteries as well," New Horizons Principal Investigator Alan Stern said.

By: Chelsea Gohd

A lunar rock sample found by Apollo 14 astronauts likely came from Earth 29

January: In 1971, astronauts aboard the Apollo 14 mission collected a Moon rock that scientists have now found likely originated on Earth. During a new investigation, researchers found that the rock, officially named 14321, contains traces of minerals and has a chemical make-up that are both common to Earth and extremely strange for the Moon. The research team thinks that, most likely, a rock that formed on Earth four billion years ago was launched to the Moon's surface by an asteroid impact.



A moon rock sample collected from the lunar surface as part of the Apollo 14 mission. NASA

Astronaut Alan Shepard hoisted the rock from the lunar surface near the edge of Cone Crater, where it had rested for millions of years, and brought it back to Earth for analysis. As the largest of the samples brought back by the mission, it was christened with the nickname 'Big Bertha'. NASA loaned the lunar rock sample in question to Curtin University in Australia, where researchers studied the Moon rock with help from researchers from the Swedish Museum of Natural History, Australian National University, and the Lunar and Planetary Institute in Houston. According to Alexander Nemchin from Curtin's School of Earth and Planetary Sciences, the 1.8-gram sample of the Moon rock had minerals similar to a granite. Different types of granite are fairly common on our home planet but extremely rare on the Moon. "The sample also contains quartz, which is an even more unusual find on the Moon," Nemchin added.

To find the sample's age, the team looked at bits of the mineral zircon embedded in its structure. "By determining the age of zircon found in the sample, we were able to pinpoint the age of the host rock at about four billion years old, making it similar to the oldest rocks on Earth," Nemchin said, adding that "the chemistry of the zircon in this sample is very different from that of every other zircon grain ever analysed in lunar samples, and remarkably similar to that of zircons found on Earth." In studying the sample closely, Nemchin and the research team concluded that the rock likely formed at a low temperature in the presence of water and oxygen - conditions commonly associated with Earth that would be extremely strange for the Moon.

It is possible - though unlikely - that this lunar rock originated on the Moon. Nemchin posited that perhaps 14321 formed under unusual conditions that appeared only briefly on the lunar surface. "However, a simpler explanation is that this piece was formed on the

Earth and brought to the surface of the Moon as a meteorite generated by an asteroid hitting Earth about four billion years ago, and throwing material into space and to the Moon,” Nemchin said. “Further impacts on the Moon at later times would have mixed the Earth rocks with lunar rocks, including at the future Apollo 14 landing site, where it was collected by astronauts and brought back home to the Earth.” By: Chelsea Gohd

Hubble’s most-used camera is back in action after malfunction 29 January: The Hubble Space Telescope’s Wide Field Camera 2 is once again operational. After issues earlier this month caused the camera to suddenly stop observations, Hubble’s Wide Field Camera 3, which was installed in 2009 when the telescope was last serviced, has taken more than 240,000 observations to date, contributed data to over 2,000 peer-reviewed published papers, and is the most-used instrument aboard the orbiting space telescope.



The Hubble Space Telescope in orbit; the telescope’s most-used camera recently became operational again after malfunctioning earlier this month. NASA

On 8 January, the telescope’s camera abruptly stopped working when it detected voltage levels outside of the expected range. That set engineers searching for what caused the problem. After investigating the issue, the team found that the voltage levels inside the camera were actually normal. Instead, data in the instrument’s telemetry circuits were not accurate. Telemetry information provides measurements of temperatures, voltages, and other vital engineering information on the function and status of the telescope and its equipment. Based on their findings, the team concluded there was a telemetry issue with the camera, while the actual voltage inside the camera was just fine. So the team reset the camera’s telemetry circuits, confirmed the instrument was working properly, and brought the camera back to life on 15 January. According to a statement from NASA, further investigation will determine why the data values were incorrect despite no actual voltage issue. The Wide Field Camera 3 became fully operational and completed its first science observations 17 January.

At almost 29 years of age, the telescope has faced a number of recent technical obstacles. In October, science observations stopped for three weeks when one of its gyroscopes failed. The gyroscopes control how the telescope points and orients itself, and this failure left the telescope with only three of its six gyroscopes operational. Three weeks later, Hubble resumed operations with these three gyroscopes. The remaining gyroscopes are expected to last longer than the gyroscopes that have already failed. By: Chelsea Gohd

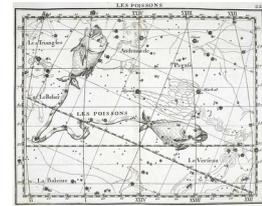
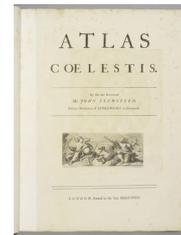
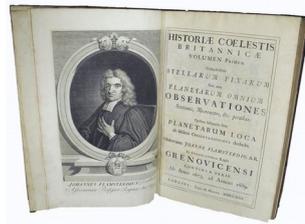
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DID YOU KNOW?

Astronomical catalogues Part 4: John Flamsteed’s catalogue: a tool to help solve the longitude problem

In 1675, John Flamsteed (1646 – 1719) was appointed the first Astronomer Royal by King Charles II. A more accurate catalogue of the fixed stars was needed to provide accurate stellar information for methods being proposed in order to accurately calculate longitude at sea. Flamsteed’s primary task was to undertake a new survey of the northern skies

using telescopic methods to improve on Tycho Brahe's *Rudolphine Tables*, the catalogue then being used in England. While Brahe's catalogue has been based on naked-eye observations, Flamsteed had the advantage of access to new technology. Although 17th century telescopes had limited capacity, they were much more capable than open sight instruments.



Greenwich Observatory John Flamsteed & *Historia Coelestis* *Atlas Coelestis*

Flamsteed spent the next 40 years observing from Greenwich Observatory and keeping meticulous records for his star catalogue. Despite requests that he release his findings in support of work on solving the ongoing longitude problem, he refused to release unverified data, keeping his incomplete records under seal. From 1704, Isaac Newton, as head of the Royal Society, tried repeatedly to persuade Flamsteed to release his findings. However, he refused to do so. It took a royal warrant from Queen Anne in 1710 to force Flamsteed to release his data. Newton, with Edmund Halley's editorial assistance, published the first, unauthorised, catalogue, in 1712. Flamsteed managed to obtain 300 of the 400 copies, and burned them.

It was not until after Flamsteed's death that his full catalogue was published. Although he had started work on it, it was his widow who arranged for the work necessary to complete it. *Historia Coelestis Britannica*, the first major star catalogue compiled with the aid of a telescope, was published in 1725. It contained details of 2,935 stars, almost three times as many stars as recorded in Brahe's sky atlas, and with greater accuracy. It soon became the standard astronomical catalogue. In 1729, his widow also arranged for compilation and publication of *Atlas Coelestis*, a set of star charts based on the catalogue.

Flamsteed's three-volume catalogue grouped stars in 55 constellations, 46 of the 48 Ptolemaic constellations and 9 which Flamsteed attributed to Hevelius. He also used his own system of what became known as Flamsteed numbers. They were similar to Bayer designations, but used numbers instead of Greek letters. Each entry's unique designation combined a number and constellation name. The numbers were applied to stars in a constellation in order of increasing right ascension. For example, 52 Cancri was a star in Cancer assigned no 52 because there were 51 other stars in the constellation which rose before this one. Several stars are still known by their Flamsteed numbers eg 61 Cygni, 47 Ursae Majoris, although, overall, Bayer's system became the norm. Flamsteed numbers only applied to stars visible from Britain, so others eg in the southern hemisphere never had Flamsteed numbers.

A century later, William Herschel noted numerous errors in Flamsteed's catalogue and asked his sister Caroline to address this issue. She found 560 stars observed, but not catalogued, and 111 catalogued, but not observed. Despite its limitations, what became known as the *British Catalogue* remained the standard catalogue for many decades.

The companion *Atlas Coelestis* contained 26 maps of constellations visible from Greenwich, and two planispheres. One of Flamsteed's main motivations to produce the

atlas was to correct representation of the figures of the constellations as made by Bayer in his 1603 Uranometria. Bayer had represented the figures viewed from behind, not from the front, as was done since Ptolemy's time. Bayer's approach had reversed the placement of stars, creating confusion. The *Atlas* was also an immediate success, becoming the standard reference for professional astronomers for almost a century, despite its high cost, large size and low perceived artistic quality. Only 16 copies are known to still exist.

Sources: Ridpath, I (Ed) (2012) Oxford dictionary of astronomy 2nd ed rev, www.astronomy.stackexchange.com, www.pbarbier.com, www.rmg.co.uk, www.en.wikipedia.org, www.en.wikisource.org

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