"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

APRIL 2018

**Monthly meeting**
This month's meeting will place on **Monday 16 April** at the **Catholic Church Hall** starting at **19.00**. Dr Sean February from the SKA in Cape Town will explain how and shy 'If you wish to make an apple pie from scratch, you must first invent the Universe'
**Cosmology meeting** Because the first Monday is a public holiday, this month, the Cosmology meeting has been postponed by a week to **Monday 9 April**

**Important notice** **2018 membership renewal window closed**
If you have not already renewed your membership, from this month, your details will be removed from the Centre's membership list. The implications of this are that you will no longer receive the monthly sky maps or Southern Cross newsletter, no longer be eligible to join Centre trips, and, if you wish to attend monthly or interest group meetings, on each occasion, you will have to pay the R20 visitor's fee. All is not lost, however. You are welcome to rejoin the Centre at any time by contacting Laura Norris, the Treasurer, at meetings, on 028 3164453 or at dunorris@whalemail.co.za

## WHAT'S UP?

**Centaurus** is more than just its two brightest stars, the well-known Pointers which appear to direct the eye towards the Southern Cross in Crux, the smallest of the 88 named constellations. In contrast, Centaurus is a large, prominent southern hemisphere constellation, ranked 9th in size. Its shape represents a centaur, s Greek mythological creature with a man's upper body and a horse's legs and hindquarters. Crux is located between the centaur's front and back legs. In addition to the Pointers (themselves the third and 11th brightest stars), Centaurus contains a number of notable features. These include the closest star to the Sun (Proxima Centauri), the largest and brightest cluster in the night sky (Omega Centauri), and a peculiar galaxy emitting strong radio signals (Cebntaurus A). These emissions are thought to be the consequence of an ongoing merging of an elliptical and a spiral galaxy. Centaurus also contains the planetary nebula the Blue Planetary (NGC 3918), named by John Herschel for its colour resemblance to smaller Uranus. It is around 2,600 light years from Earth.

## LAST MONTH'S ACTIVITIES

**Monthly centre meeting** The speaker at the meeting held on 19 March was Dr Pieter Kotzé, Senior research fellow at SANSA in Hermanus. He gave a fascinating and informative talk on 'The current status of Earth's magnetic field. Is it disappearing? After

outlining the source and characteristics of Earth's magnetic field, Pieter then summarised the role which South Africa has played, and continues to play, in investigating, understanding and monitoring the field over several centuries.

He then illustrated how Earth's magnetic field is inherently dynamic and variable, influenced by factors like the Sun's passage during the day as well as long term changes in global magnetic behaviour. The South Atlantic Anomaly, where the magnetic field is weakening markedly is an important, current focus of study. Pieter explained how evidence of past reversals of Earth's magnetic filed, locked into iron-rich rocks, shows that these did not cause extinction events and that what appears to be the current field reversal is unlikely to do so either. The danger comes not from magnetic north becoming magnetic south south, but from the effects of cosmic rays. Presently, the atmosphere keeps these dangerous rays away from Earth's surface. However, the process of magnetic reversal weakens this defence, enabling cosmic rays to reach closer to the surface.

## Interest groups

**Cosmology** Those who attended the meeting on 5 March watched the next two episodes of the new DVD series: The Higgs boson and beyond by Dr Sean Carroll, Research Professor of physics at CalTech. These episodes were Lecture 3: 'Atoms to particles ' and Lecture 4: 'The power of symmetry'.

**Astro-photography** Image processing was the focus of the meeting on 12 March.

## Other activities

**Educational outreach**

**Hawston Secondary School Space Cadets** Meetings with the new group of space cadets continued during March.

**Lukhanyo Youth Club** No meeting took place in March.

**Stargazing** On 22 March, 25 learners (13 from Lukhanyo, 4 from Hawston and 9 from Mount Pleasant) attended an evening of moon and stargazing on Rotary Way. The wind was chilly, but the skies clear and bright. The focus was on the Moon, but they also saw the Southern Cross and Pointers, Orion, Sirius, the Orion nebula and the Jewel Box.

A public stargazing event was scheduled to take place as part of the Earth Hour event in Onrus on 24 March. Unfortunately, cloudy skies prevented this from taking place.

**ASSA symposium** Pierre de Villiers and Jenny Morris attended the very interesting first day of the 'Astronomical history' symposium at the SAAO in Cape Town on 7 March.

**Southern Star Party** Bennie Kotze reports: "Previously called The Southern Star Party but, with a lesser structured arrangement, it was renamed as the Extended – Deep Sky Weekend. The venue was in the Bonnievale district, not really conducive to stargazing.

During the afternoon of 15 March, Pierre (de Villiers), John (Saunders), Peter (Harvey) and I arrived at the farmhouse, Oppi-Koppi, our abode for the next four days. As expected, the skies looked ominous and stargazing was not on the agenda for that evening. With the afternoon available and the memories of a very pleasant visit to the Bonnievale Cellars some two years ago, we left to revisit and to relive the taste of fine and exquisite wines, a produce of this area. The evening went by with an in-depth and interesting discussion on astronomy, the talks blended with the aroma and bouquet of fine wine.

On Friday I drove the group to McGregor to explore the town and ended the visit enjoying a cup of coffee at a vintage building restored as an eatery. We awaited the evening with trepidation, hoping and wishing the clouds would clear up. Stargazing was possible but only for a short while, the rest of the evening jeopardised by clouds moving in very fast.

The Saturday evening came, the skies were clear, dark and filled with stars, and we were elated. Pierre had some adjustments and additions made to his observatory trailer with positive results: he finally was able to fine tune his 132mm refractor telescope. He was ecstatic, his mobile telescope is now declared fully operative. Well done Pierre, this was a massive project which required persistence and commitment and you have done it. Peter, tried very hard the whole evening to hunt down the Ghost of Jupiter, but to no avail. He, however, had a profitable evening exploring the skies.

John was somewhat disheartened as he could not get his telescope to focus. It was stacked away for a number of years during his stay in the UK. Pierre and I went to assist and had John smiling within a few minutes leaving him happy to explore the skies again. I enjoyed some excellent viewing, I started the evening by setting my Go To telescope on Tour mode and viewed many objects as I toured the skies through 360 degrees. My favourite, 47 Tucanae, I revisited many times during the evening. Midnight had come and gone and we called it a day at about 1am. A review followed of the evening's viewing over a cup of coffee. We concluded that if we had to choose an object which left the biggest impression, it had to be the Eta Carinae Nebulae. The next morning we all concluded that a fantastic weekend was had by all and the best stargazing experience to date.

**Whale Talk article** An article by Jenny Morris titled 'MeerKAT: big science in the Karoo' was published in the March/April issue of the magazine.

## THIS MONTH'S ACTIVITIES

### Monthly centre meeting

This month's meeting, will take place on **Monday 16 Apri**l at the **Catholic Hall** starting at **19.00**. Dr Sean February from SKA in Cape Town will be explaining how and why "If you wish to make an apple pie from scratch, you must first invent the Universe'. Details about the speaker and the presentation will be circulated in due course.

There is an entrance fee of R10 per person for members, R20 per person for non-members, and R10 for children, students and U3A members.

### Interest group meetings

The **Cosmology** group meets on the first Monday of each month at 19.00. The next meeting will take place on **9 April** at the **Catholic Hall**, starting at **19.00**. Attendees will watch the next two episodes in the DVD series: The Higgs boson and beyond by Dr Sean Carroll, Research Professor of physics at CalTech. The content will be Lecture 5 'The Higgs field' and Lecture 6: 'Mass and energy'.

There is an entrance fee of R10 per person for members, R20 per person for non-members, and R10 for children, students and U3A members. For further information on these meetings, or any of the group's activities, please contact Pierre Hugo at pierre@hermanus.co.za

**Astro-photography** This group meets on the second Monday of each month. There is no meeting in April. The next meeting is on **14 May.** The topic will be image processing.

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** Organisers are progressing with work towards enabling learners to take and process images themselves.

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

## FUTURE ACTIVITIES

No trips are being planned, at present.

## 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**. Details for the first few months are:

| | |
|---|---|
| 16 April | 'If you wish to make an apple pie from scratch, you must first invent the Universe' Presenter: Dr Sean February, SKA, Cape Town |
| 21 May | 'Recent and ongoing work on pulsar light curves' Presenter: Andre van Staden |
| 18 June | 'The story of Hermanus Astronomy Club/Centre' Presenters: Pierre de Villiers and John Saunders, Centre members |
| 16 July | 'History of the Voyager spacecraft' Presenter: Johan Retief, Centre member |
| 20 August | TBA |
| 17 September | TBA |
| 22 October | 'Our weird and wonderful Universe' Presenter: John Saunders, Centre member |
| 19 November | 'Table Mountains: geology and astronomy' Presenter: Jenny Morris, Centre member |
| 10 December | Xmas party |

## ASTRONOMY EDUCATION CENTRE AND AMPHITHEATRE (AECA)

Consideration of the planning application by the Council of Overstrand Municipality continues to be awaited. Hopefully, the additional information requested by staff will enable this to take place soon. 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.

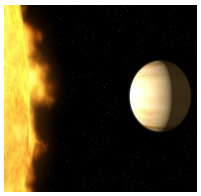
We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer, 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

**Hubble reveals the most detailed exoplanet atmosphere seen to date** 8 March: A team of British and US researchers combined new data from NASA/ESA's Hubble Space Telescope with previous data from NASA's Spitzer Space Telescope and ESO's Very Large Telescope to create an amazingly detailed atmospheric analysis of exoplanet WASP-39b The results are the most in-depth analysis of an exoplanet atmosphere possible with available technology.



WASP-39b is classified as a hot-Saturn that orbits a star similar to the Sun, 700 light-years from Earth. NASA, ESA, and G. Bacon (STScI)

An absence of high-altitude atmospheric clouds gave Hubble a clear view deeper inside WASP-39b, making it the perfect target for observation. The exoplanet sits 700 light-years from Earth and orbits a star similar to the Sun. Because WASP-39b is comparable in mass to Saturn but is much closer to its star than Saturn is to the Sun, it is categorized as a 'hot Saturn'. The name gives away the obvious temperature disparity: WASP-39b is a sweltering 750 degrees Celsius, while Saturn averages -142 degrees Celsius. The exoplanet is tidally locked to its sun, meaning the same side faces its star all the time, but the world's strong winds blast enough heat to its dark side to make both sides equally hot.

It was predicted that, like Saturn, WASP-39b would be home to water vapour. The team tested this by analysing the starlight that passed through the exoplanet's atmosphere. As starlight travels through the atmosphere, it combines with emission from atmospheric atoms and molecules into a single signal. By examining the spectrum and removing the components due to starlight, researchers were able to see the types and amounts of atmospheric gas present.

They found that WASP-39b has much more water than expected, about three times the amount that Saturn has. The high amount of water implies that at one point, the exoplanet was blasted with large amounts of icy materials that accumulated in its atmosphere. However, this would not have been possible with the scorching temperatures raining down from its host star. The researchers believe that WASP-39b actually formed eight times farther away from its star than sits now and proceeded to make a significant trek inward over time. By: Amber Jorgenson

**All disk galaxies rotate once every billion years** 13 March: Astronomers have announced the discovery that all disk galaxies rotate about once every billion years, no matter their size or mass. "It's not Swiss watch precision," said Gerhardt Meurer, an astronomer from the International Centre for Radio Astronomy Research (ICRAR). "But regardless of whether a galaxy is very big or very small, if you could sit on the extreme edge of its disk as it spins, it would take you about a billion years to go all the way round." He added, "Discovering such regularity in galaxies really helps us to better understand the mechanics that make them tick. You won't find a dense galaxy rotating quickly, while another with the same size but lower density is rotating more slowly."

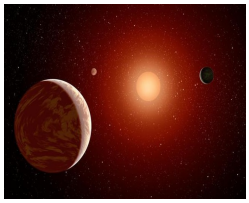

Grand spiral galaxy (NGC 1232). FORS/8.2-meter VLT Antu/ESO

The researchers measured the radial velocities of neutral hydrogen in the outer disks of a plethora of galaxies - ranging from small dwarf irregulars to massive spirals. These galaxies differed in both size and rotational velocity by up to a factor of 30. With these radial velocity measurements, the researchers were able to calculate the rotational period of their sample galaxies, which led them to conclude that the outer rims of all disk galaxies take roughly a billion years to complete one rotation. However, the researchers note that further research is required to confirm the clock-like spin rate is a universal trait of disk galaxies and not just a result of selection bias.

Based on theoretical models, the researchers also expected to find only sparse populations of young stars and interstellar gas on the outskirts of these galaxies. Iinstead, they discovered a significant population of much older stars mingling with the young stars and gas. "This is an important result because knowing where a galaxy ends means we astronomers can limit our observations and not waste time, effort, and computer processing power on studying data from beyond that point," said Meurer. "So because of this work, we now know that galaxies rotate once every billion years, with a sharp edge that's populated with a mixture of interstellar gas [and] both old and young stars."

By: Jake Parks

**Potentially habitable super-Earth found during exoplanet search** 14 March: With the help of space- and ground-based telescopes, a group of researchers surveying red dwarf stars near Earth identified 15 new exoplanets - and one of them has the potential to host liquid water.


A recent study of red dwarfs near Earth uncovered 15 never-before-seen exoplanets in their orbits. NASA/JPL-Caltech

The team of researchers, led by Teruyuki Hirano of Tokyo Institute of Technology's Department of Earth and Planetary Sciences, used data from NASA's Kepler spacecraft and observations from Spain's Nordic Optical Telescope and Hawaii's Subaru Telescope to carry out the study.

The 'star' of the study is K2-155, a bright red dwarf about 200 light-years away. The researchers found three super-Earths (planets larger than Earth but smaller than Neptune) orbiting the star, with the farthest planet, K2-155d, potentially in its habitable zone. By measuring the radius of K2-155d, which is estimated at about 1.6 times that of Earth, and using a 3-D global climate simulation, they found it is highly probable that liquid water could exist on its surface. The team cannot say this with certainty, though, because the unmeasured radius and temperature of its host star could impact K2-155d's habitability — habitability that also depends on the assumptions that go into the simulation. "In our

simulations, the atmosphere and the composition of the planet were assumed to be Earth-like, and there's no guarantee that this is the case," said Hirano.

It addition to studying K2-155d, the team evaluated the similarities and differences between planets that orbit solar-type stars, like the Sun, and planets that orbit red dwarfs. They found that both types of systems have similar radius gaps among their planets, meaning that neither is likely to harbour planets with radii between 1.5 to 2 times that of Earth. The researchers believe this gap may be due to photoevaporation, which rids planets of their outer atmospheric envelope if they get too close to their host star, shedding mass in the process. By: Amber Jorgenson

**Comets and asteroids shower Mars with organics** 16 March: For decades, astronomers suspected that Mars might be teeming with organics, which are carbon-based molecules like proteins, carbohydrates, and nucleic acids. However, it was not until 2015 that the Mars Curiosity rover uncovered the first evidence showing these life-supporting compounds were not only present, but also likely scattered all over the Red Planet. At the time, astronomers suspected that organics were hitchhiking to Mars almost exclusively aboard tiny, interplanetary dust particles (which are incredibly common and cause most meteors here on Earth). However, just three years later, new research suggests otherwise.

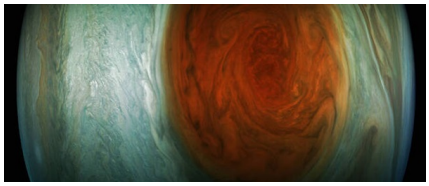
Artist's concept (from a proposed but not flown Mars Scout mission) shows the impact of a high-velocity probe similar to a large meteorite. Arizona State University/Ron Miller

An international team of researchers has found that about one-third of the organic material on Mars was delivered there by asteroid and comet strikes. To determine this, they created a computer model of the solar system that included hundreds of thousands of asteroids and comets. Then they used Peregrine,a supercomputer at the University of Groningen in the Netherlands, to run multiple simulations. After running the simulations for a few weeks, the researchers were surprised to find that comets and asteroids are likely responsible for about one-third of the 192 tons of carbon that plummets to Mars each year. More specifically, they found that asteroids deliver about 50 tons of the organic material per year (26 percent), while comets account for around 13 tons (7 percent).

These findings fit in neatly with the recent discovery that organic molecules make up near half of Copmet 67P which was visited by the Rosetta spacecraft in 2014. Furthermore, unlike interplanetary dust infall, which distributes organics somewhat evenly over the entire Martian surface, organics delivered by asteroids and comets were found to be concentrated within about 150 km of impact craters. This is an important finding because it could affect the analysis of in-situ samples taken by current and future Mars rovers.

The new findings not only have implications for future Mars missions, but also for exoplanetary research. According to Kateryna Frantseva, a Ph.D. student at the University of Groningen. "Near other stars, there are also exo-asteroids and exo-comets that can shower the surfaces of exoplanets with carbon. If, on top of that, there is water, then you have the required ingredients for life." By: Jake Parks

**Jupiter's Great Red Spot is shrinking in length, but growing in height** 16 March: Jupiter's Great Red Spot may not be losing its greatness after all. Although the storm has been dwindling for about a century and a half, a new study shows that, while its length continues to decrease, its height is actually increasing. The new discovery adds to the storm's list of unpredictable behaviours. "Storms are dynamic, and that's what we see with the Great Red Spot. It's constantly changing in size and shape, and its winds shift, as well," said Amy Simon, planetary atmosphere expert at NASA's Goddard Space Flight Centre.


Jupiter's Great Red Spot, the planet's massive storm, is going through some unexpected changes. NASA/JPL-Caltech/SwRI/MSSS/Gerald Eichstädt

Observations of the Great Red Spot have been quite extensive over the years, giving researchers a solid record to look back on. The first confirmed observation dates back to 1831, and although technology was not too advanced at the time, observers were able to track the storm's size and drift by placing eyepieces marked with crosshairs on their telescopes. By using this technique, and other methods as technology advanced, observations have been logged at least once a year since 1878. More recent data has been collected by the two Voyager missions, starting in 1979, and yearly observations by the Outer Planets Atmospheres Legacy program, which uses NASA's Hubble Space Telescope and is run by scientists from NASA's Jet Propulsion Laboratory and the University of California at Berkeley.

Simon and her team of researchers combined these records to study changes in the storm's size, colour, shape, drift rate, and wind speed, and found that the Great Red Spot is now only about a third the size of its 1878 width. At one point, the storm was large enough to house three Earths, but now it is barely large enough to harbour one. The decrease in size has not been constant. In the 1920s, the storm actually grew for a short period of time before continuing to shrink again. "There is evidence in the archived observations that the Great Red Spot has grown and shrunk over time," said Reta Beebe, an emeritus professor at New Mexico State University in Las Cruces. "However, the storm is quite small now, and it's been a long time since it last grew."

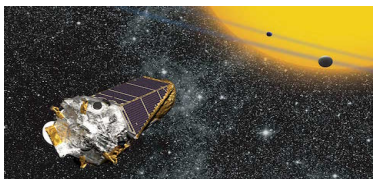
The strange storm travels westward, opposite Jupiter's eastward rotation. It was previously believed to move at a constant rate; however, the study found that it is travelling through Jupiter's atmosphere faster now than in the past. Researchers also discovered, surprisingly, that no change in internal wind speed has occurred over time. Since the storm is becoming more compact, they expected the winds to become stronger, but found that the wind is travelling at the same speed that it was before. Rather than gusting more fiercely at its base, the storm is instead growing taller.

Another noteworthy development is that the Great Red Spot is not so red anymore. It is actually been turning a deep orange since 2014. The researchers think that the increasingly tall storm could be carrying the chemicals responsible for its colour higher into Jupiter's atmosphere, increasing their exposure to UV radiation and causing their colour to

change. However, further research is needed to corroborate this theory.

By: Amber Jorgenson

**NASA's Kepler space telescope is running out of fuel** 21 March: NASA's Kepler spacecraft has delivered groundbreaking data to the science community during its remarkable nine-year journey. Its hunt for Earth-like planets in habitable zones of stars has not only assisted in the search for extraterrestrial life, but also provided crucial clues to the formation of our universe. Sadly, though, the exoplanet-hunting telescope is not exempt from the cheesy "all good things must come to an end" expression. After almost a decade in space, Kepler is expected to run out of fuel within the next few months. Although its expiration is inevitable, its legacy will burn indefinitely.



Despite losing its second of four reaction wheels in 2013, the Kepler mission continues to carry out short-term exoplanet hunting campaigns as it runs out of fuel. NASA/Kepler Mission/Wendy Stenzel

Without a fuel gauge, Kepler's demise is simply estimation, and it has not shown signs of slowing down just yet. NASA is continually monitoring the craft for signs of low fuel, like changes in thruster performance and fuel tank pressure, but no warnings have arisen so far. Kepler will continue to carry out research campaigns and send scientific data back to Earth until its thrusters, which are needed to aim the spacecraft and transmit data, begin to show signs of fuel depletion.

Spacecraft typically have to reserve fuel for a final finish, like Cassini's final descent into Saturn's atmosphere, so they do not collide with other satellites, contaminate extra-terrestrial environments, or come crashing down to Earth. Kepler, however, is in an isolated area 151 million km from Earth, so its last bit of fuel can be used to continue observing and collecting data.

Kepler, which launched from Florida's Cape Canaveral Air Force Station on 6 March 2009, had a specific assignment - survey our area of the Milky Way for Earth-size planets within habitable zones of stars. Its mission was to keep a continuous eye on a specific galactic zone that houses roughly 150,000 Sun-like stars and search for the faint dimming that occurs when a planet orbits its host star. Unfortunately, this mission was cut short in May 2013, when Kepler's second of four reaction wheels, which stabilise the craft, broke. At that point, the orbiting observatory had confirmed the existence of 2,342 exoplanets.

Though the original mission had met its end, rather than calling it a wash, NASA found a way to push through. By precisely shifting the orientation of Kepler so that it was positioned almost parallel to its direction of travel, engineers managed to use the solar wind to steady the telescope. With the pressure of the solar wind acting as a third stabilization wheel, Kepler could again rotate in all three dimensions and orient itself for targeted observations. However, due to Kepler's changing orbital position, this method only allowed astronomers to observe specific regions for about three months. Fortunately, that is plenty of time to collect valuable scientific data. This resulted in the follow-up mission famously dubbed K2. K2 began operating in May 2014, a year after Kepler's initial

injury, and carries out roughly 80 day observing campaigns of stars located around the ecliptic plane. The Kepler team initially thought the remaining fuel would power K2 though 10 campaigns, but in March 2018, it began its 17th campaign. To date, K2 has identified 307 confirmed exoplanets, as well as nearly 500 potential candidates.

By: Amber Jorgenson

**Artificial intelligence identifies 6,000 new craters on the Moon** 23 March: Despite vast developments in technology over the last few decades, our method for counting craters on the Moon has not advanced much, with the human eye still being heavily relied on for identification. In an effort to eliminate the monotony of tracking lunar cavities and basins manually, a group of researchers at the University of Toronto Scarborough came up with an innovative technique that resulted in the discovery of 6,000 new craters.


The image shows Daedalus, a crater on the far side of the Moon, sitting in heavily cratered terrain. NASA

"Basically, we need to manually look at an image, locate and count the craters, and then calculate how large they are based off the size of the image. Here we've developed a technique from artificial intelligence that can automate this entire process that saves significant time and effort," said Mohamad Ali-Dib, a postdoctoral fellow at University of Toronto's Centre for Planetary Sciences and co-developer of the technology.

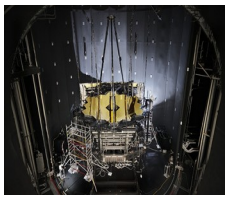
The method utilises a convolutional neural network, the same machine learning algorithm used for computer vision and self-driving cars. The research team used data from elevation maps, collected by orbiting satellites, to train the algorithm on an area that covers two-thirds of the Moon's surface. They then tested the technology on the remaining third, an area it hadn't yet seen. The algorithm was able to map the unseen terrain with incredible accuracy and great detail. It identified twice as many craters as manual methods, with about 6,000 new lunar craters being discovered.

"Tens of thousands of unidentified small craters are on the Moon, and it's unrealistic for humans to efficiently characterize them all by eye," said Ari Silburt, a former University of Toronto Department of Astronomy and Astrophysics grad student, who helped create the AI algorithm. "There's real potential for machines to help identify these small craters and reveal undiscovered clues about the formation of our solar system."

Because the Moon does not have flowing water, plate tectonics, or an atmosphere, its surface undergoes very little erosion. With its ancient craters remaining relatively intact, researchers are able to study factors like size, age, and impact to gain insight into our solar system's evolution and the material distribution that occurred early on. Ali-Dib and his research team plan to keep improving the algorithm and eventually test it on celestial objects like Mars and the moons of Saturn and Jupiter. By: Amber Jorgenson

**James Webb will now launch in 2020** 27 March: The James Webb Space Telescope (JWST) is one of the most highly anticipated observatories among astronomers. This infrared space telescope will revolutionise our ability to detect and characterise

exoplanets, study the very early universe, and peer deep into the dusty clouds where stars are born. However, we will have to wait just a little longer. JWST's previously updated launch window of early 2019 has now been again revised, based on the need for additional testing and evaluation. The telescope is now slated to launch in May 2020.


The James Webb Space Telescope is a collaborative project backed by NASA, the European Space Agency, and the Canadian Space Agency. NASA/Chris Gunn

Launching a project of this size and scope will be an amazing achievement, but it is not without its challenges. Each part of the observatory must undergo rigorous testing, often both separately and once integrated into the whole, before it can be considered fit for launch. This is the main reason for the additional delay, said acting NASA Administrator Robert Lightfoot. "All the observatory's flight hardware is now complete, however, the issues brought to light with the spacecraft element are prompting us to take the necessary steps to refocus our efforts on the completion of this ambitious and complex observatory."

Testing is extremely important for any observatory, but this one perhaps more so than previous projects. Unlike the Hubble Space Telescope, which was placed in Earth orbit and accessible for repairs and upgrades, JWST will share Earth's orbit around the Sun from a point called L2. This position, about 1.5 million km away, will help to keep the telescope cool, which is vital in infrared astronomy (Hubble, by comparison, is an optical telescope, so it does not face this requirement). Add to that the spacecraft's complex transition from its launch configuration, during which its large sunshield and primary mirror will be folded up, to its final design, with a 6.5-meter primary mirror (Hubble's is just over 2 meters) and a sunshield spanning nearly 21 x 14m, and testing the telescope's many components becomes vital.

This delay is, admittedly, one in a long line of additional launch date pushbacks. But such delays ensure that engineers and scientists have the time they need to test and combine components, then test again. In 2011, Congress imposed a cost cap of $8 billion, rather than cancel the project after several prior cost adjustments and schedule changes. Since then, most of the spacecraft's manufacturing and testing has proceeded on schedule, but more recent challenges as the entire project comes together have caused additional delays. Those delays, engineers stress, are necessary to ensure the massive telescope will work as expected, as needed, the first time. Just because elements work perfectly when separate does not mean they will do the same when combined, which is why extra testing is needed. "Considering the investment NASA and our international partners have made, we want to proceed systematically through these last tests, with the additional time necessary, to be ready for a May 2020 launch," stressed Thomas Zurbuchen, who serves as associate administrator for NASA's Science Mission Directorate.

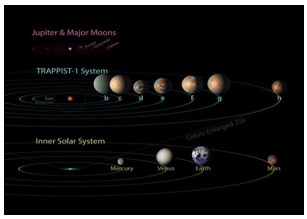
Where does the project stand currently? Both the science payload - the instruments - and the spacecraft bus, which contains its structural and flight components, are now together for the first time at Northrop Grumman's facility in Redondo Beach, California. The telescope has passed a milestone 100-day test in a vacuum chamber to simulate conditions in space, and its delicate sunshield has been completely packed into its launch

configuration and successfully unfurled (no easy task, considering it is designed to do so in zero gravity, which can't be achieved on the ground). The next big test Webb will need to pass is the environmental testing that ensures the spacecraft can withstand the stresses of launch atop a rocket. After that, engineers plan to finally assemble the complete observatory and check that all its systems work in concert. By: Alison Klesman

**TRAPPIST-1 system may have too much water to support life** 28 March: Hope was ignited in the science community when researchers discovered that three of the seven Earth-size planets orbiting TRAPPIST-1, a cool red dwarf about 40 light-years from Earth, are within the star's habitable zone and could have flowing water on their surfaces. However, while the presence of water undoubtedly increases the likelihood of habitability for these planets, it does not automatically make them safe havens for life. In fact, an overabundance of water suggests just the opposite. New research by scientists at Arizona State and Vanderbilt Universities indicates that the TRAPPIST-1 system actually has too much water to support life.

Each of TRAPPIST-1's planets are roughly the size of Earth and are tightly packed together, with all of their orbits keeping them closer to their host star than Mercury is to the Sun. While the exoplanet's are similar in size to Earth, measurements of their masses and volumes show that they're much less dense. They are too light to be rocky and, unlike other low-density planets of similar size, too compact to be primarily composed of atmospheric gas."The TRAPPIST-1 planets are too small in mass to hold onto enough gas to make up the density deficit," said Arizona State University geoscientist, Cayman Unterborn. "Even if they were able to hold onto the gas, the amount needed to make up the density deficit would make the planet much puffier than we see."

With rock and atmospheric gas ruled out, the research team determined that the system's abundant component is likely water. However, just how much water is needed to make up the exoplanets' masses remained unknown. To find out, the researchers developed software called ExoPlex, which merged all of the available data for the TRAPPIST-1 system into one platform. By analyzing the host star's chemical composition, along with the mass and radius of each planet, the software estimated that the two innermost planets ('b' and 'c' on the image below) have less than 15% water by mass, while two of the outer planets 'f' and 'g') have over 50% water by mass. Keeping in mind that Earth is just 0.02 percent water by mass, the difference is pretty substantial.



Researchers believe that TRAPPIST-1's innermost exoplanets are about 15% water by mass, and outer planets could be over 50%. NASA/JPL- Caltech

"We typically think having liquid water on a planet as a way to start life, since life, as we know it on Earth, is composed mostly of water and requires it to live," said researcher Natalie Hinkel of Vanderbilt University. "However, a planet that is a water world, or one that doesn't have any surface above the water, does not have the important geochemical or elemental cycles that are absolutely necessary for life."

In addition to learning about TRAPPIST-1's habitability (or lack thereof), the researchers also learned about the system's formation and evolution. Stars like TRAPPIST-1 become their hottest and brightest following their formation, and they proceed to dim over time. When TRAPPIST-1 formed, so did its 'ice line', the boundary where a planet's water starts to turn into ice. By examining planetary ice, the researchers determined that TRAPPIST-1's ice line moved inward as the star aged and lost heat - but so did its planets.

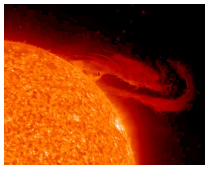
It is believed that the planets initially formed farther away from the star than they sit now and later underwent an inward migration. Over time, they ended up twice as close to their host star as they were when they first formed, impacting which side of the ice line they fall on. The discovery gives insight into how planetary systems evolve over time, and how the physical state of a planet's water can change during its host star's lifetime.

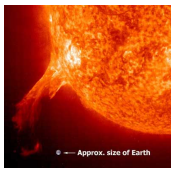
By: Amber Jorgenson

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

DID YOU KNOW?

**The Sun** Part 25: **Solar flares**






These are a sudden release of energy in the Sun's corona, visible as flashes of brightness erupting from above the Sun's surface. They usually occur within about 175,000 km of the photosphere and can last up to several hours and, exceptionally, as long as a day. Frequency of flare occurrence varies from several per day when the Sun is particularly active to less than one a week when it is quiet. Large flares are less frequent than smaller ones. Flare frequency shows a pattern which follows the 11-year solar cycle.

They emit radiation across the whole spectrum. Travelling at the speed of light, this can reach Earth in around eight minutes. A flare also ejects clouds of electrons, ions and atoms through the corona into space. Only the most energetic are visible in white light. If a flare is directed towards Earth, its energetic particles, travelling up to 70% of the speed of light, can arrive within 15 minutes.

The first observation of a solar flare occurred in 1859. While observing sunspots through his optical telescope with a solar filter, the English astronomer Richard Carrington observed a very intense white light flare. The event was also independently observed by Richard Hodgson, an amateur astronomer. Carrington's observation was confirmed by a blip in the tracing of a nearby magnetometer. This blip is now known to have been caused by the effect of the flare's X-ray energetic particles on Earth's ionosphere. At the time, however, X-rays had not yet been discovered, nor the existence of the ionosphere recognised. What these two men observed was, in fact, the most powerful flare ever observed, to date, which is why it was so visible. The solar storm of 1859 is known as the Carrington event.

The flare left a trace in Greenland ice and, for many years, this was the only source of information on flares. In 1942, radar operator Stanley Hey unintentionally observed radiation which he interpreted as solar emission. Others found the same, but the discovery

only went public in 1945 after World War 2 ended. Following the first radio astronomy solar observations, which began in 1843, later radio astronomers identified several features of solar activity including solar flares. Radio telescopes continue to be important for flare observation.

More recently, space telescopes became useful tools for observing solar flares. Located beyond the atmosphere, which absorbs wavelengths shorter than ultraviolet, they operate at X-ray wavelengths, where flares may be very bright. Flares are also observed from dedicated Earth-based solar telescopes.

Flares occur when accelerated charged particles, mainly electrons, interact with the plasma medium in active regions round sunspots, where intense magnetic fields penetrate the photosphere to link the corona to the Sun's interior. Acceleration of the charged particles is a result of magnetic reconnection, often in solar arcades (series of closely occurring loops of magnetic lines of force). Reconnection is a physical process in which highly stretched or twisted magnetic field rapidly relaxes into low-stress configurations. The process can leave unconnected areas of field, which initiates a sudden release of energy and particles as flares. This explains why flares typically erupt from active regions of the Sun where magnetic fields are much stronger, on average.

Although the cause of solar flares is understood, is is unclear how magnetic energy is transformed into particle kinetic energy, nor how particles are accelerated to such high energies. Also, like other features of solar activity, scientists are unable to forecast the occurrence of flares, although their association with sunspots can provide some opportunity, although only as probabilities.

Solar flares affect all layers of the solar atmosphere; photosphere, chromosphere and corona. The plasma medium is heated to tens of millions K while the electrons, protons and heavier ions are accelerated near to the speed of light. They produce radiation across all wavelengths of the electromagnetic spectrum, from gamma to radio. Most energy is spread over frequencies outside visual range, so the majority of flares are only observable with special instruments. The same energy release producing flares can also produce larger coronal mass ejections (CME) and this is often the case. However, causal links between these and flares are not well established

**Hazards** Flares strongly influence local space weather. The solar wind carries their streams of highly energetic particles and can impact Earth's magnetosphere, causing geomagnetic storms and presenting radiation hazards to spacecraft and astronauts. If accompanied by CMEs, they can trigger storms powerful enough to disable satellites and knock out power grids. X-ray and ultraviolet radiation from flares can affect the ionosphere and disrupt long range radio communications. X-ray radiation can also heat the outer atmosphere, increasing drag on satellites and leading to orbital decay.

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

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

COMMITTEE MEMBERS

| | |
|---|---|
| Pierre de Villiers (Chairperson, AECA) | 028 314 0830 |
| Laura Norris (Treasurer) | 028 316 4453 |
| Peter Harvey (Secretary, sky notes) | 028 316 3486 |

| | |
|---|---|
| Jenny Morris (Vice-chairperson, newsletter) | 071 350 5560 |
| Derek Duckitt (Website editor) | 082 414 4024 |
| Bennie Kotze (Outreach co-ordinator, youth clubs) | 028 316 3666 |
| Deon Krige (Youth robotics project, astro-photography) | 028 314 1045 |
| Non-committee members with roles: | |
| Pierre Hugo (Cosmology interest group) | 028 312 1639 |
| Johan Retief (Membership, Hawston School Youth Club) | 028 315 1132 |
| John Saunders (Events co-ordinator) | 028 316 2302 |