"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

DECEMBER 2017

2017 Christmas party

This takes place on **Monday 11 December** at the **Catholic Church Hall** starting at **18.30** for **19.00**. This will be a celebration of the ten years since the Hermanus Centre was founded. Bookings closed on 30 November, but contact John Saunders at antares@hermanus.co.za if you are still interested in attending.

Membership renewal for 2018

The fees for 2018 are unchanged. They are as follows:

Member: R150

Member's spouse/partner/child, student: R75

Six-month membership from July – December 2017:

Member: R75 Member's spouse etc, student: R40

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.

Monthly meeting dates for 2018

Dates for your diaries are: 22 January, 19 February, 19 March, 16 April, 21 May, 19 June, 16 July, 20 August, 17 September, 22 October, 19 November and 10 December.

WHAT'S UP?

Three interesting facts about the Moon this month Firstly, the Full Moon on the 3rd will be the largest in 2017 ie a super-moon. However, it will not be as large or notable as the super-moon of 14 November 2016. A super-moon occurs when a full moon coincides with a perigee (time when the Moon's elliptical orbit brings it closest to Earth). The distance of the Moon from Earth varies from around 357,000 km during perigees to around 406,000 km at apogees. Secondly, on the 19th the Moon will be at the greatest apogee in 2017, at a distance of 406,604 km. Finally, also on the 19th , near New Moon, the Moon will be the furthest south in 2017, at -20.1° south of the ecliptic. While a new

moon rises and sets with the Sun, a full moon does the opposite ie rises at sunset, and in the east (while the Sun sets in the west). Because of Earth's 23° tilt from the vertical we experience seasons. The tilt also means that the position of moonrise and moonset at different times of the year also changes. During the southern summer, the new moon rises with the Sun towards the south-east and sets with the Sun towards the south-west. In contrast, the full moon rises towards the north-east and sets towards the north-west. The opposite is true during the southern winter.

LAST MONTH'S ACTIVITIES

Monthly centre meeting The presenter on 20 November was Amoré Nel, a doctoral student based at SANSA. Her topic was 'The mysteries of the black auroras'. After outlining the range of activities undertaken at SANSA, Amoré explained how auroras reflect what is going on in the Sun. The increased volumes of particles released during solar activity, like flares or storms, which reach Earth are caught in its magnetic field lines. The energy is then funnelled down the lines towards the poles, where, when they interact with gas particles in the ionosphere, they produce colourful auroras.

Amoré then moved onto the topic of black auroras. These are small dark areas which have been observed within some auroras. The mystery is why they are there and how they are formed. Her research is adding to the currently limited knowledge and understanding of these well-defined, discrete features. She is using data obtained from the EISCAT scatter radar system, located in northern Scandinavia, and optical auroral images to improve understanding of the mechanisms of these intriguing structures. She has made some interesting findings eg they have lower energies than surrounding normal aurora, suggesting that something is blocking energy strength in these particular regions. However, there is still much to learn, and it was clear that Amoré is committed to continue to study these mysterious phenomena.

Interest groups

Cosmology 13 people (11 members, 2 visitors attended the meeting on 6 November. They watched another two episodes in the DVD series: Particle Physics for Non-Physicists: a Tour of the Microcosmos' by Prof Steven Pollock, Professor of physics at the University of Colorado at Boulder. These episodes were Lecture 19: 'The Higgs particle' and Lecture 20: The solar neutrino puzzle'.
Astro-photography Image processing problems were discussed at the 13 November meeting.

Other activities

Educational outreach
Hawston Secondary School Astronomy Group Meetings in 2017 stopped before the start of matric exams.
Lukhanyo Youth Club No meetings took place while members attended a series of workshops being run by SANSA staff during 2017.

Southern Star Party Two members attended the Southern Star Party held from 18-23 October near Robertson.
Visit to MeerKat near Carnarvon On 24 November, nineteen Centre members and partners were taken on a fascinating guided tour of the SKA site north-west of Carnarvon. Locations visited included the computer processing plant, dish assembly building, KAT7 pathfinder installation, HERA installation, and the recently completed 64 dishes which form

MeerKAT. The facts and experiences associated with SKA and the tour could fill a newsletter, so only a few of the many highlights are outlined below:

- SKA's unique potential for unlocking distant, early secrets of the universe;
- the sheer physical scale of the project is impressive, even with only 7 KAT dishes and the 64 MeerKAT dishes completed. 3,200 dishes will eventually extend across half of Africa, and there will also be the extensive low frequency installation in Australia;
- the largest computer in the southern hemisphere is currently under development;
- when operational, SKA will produce 4x the data than is currently produced globally;
- the benefits to South African industry and the local workforce during construction and future operation are notable. Up to 75% of materials, equipment and components were sourced in South Africa;
- the fact that a cell phone signal reaches Pluto reinforces the need for banning of cell phones and digital cameras near the site. Even hearing aids and pacemakers affect the very sensitive equipment;
- The lowtech wooden pole and chicken wire receivers of the HERA experiment are able to detect the microwave emissions of the oldest stars and galaxies.

THIS MONTH'S ACTIVITIES

Monthly centre meeting

This month's meeting will take place on **Monday 11 December** at the **Catholic Hall** starting at **19.00**. It will be the annual Christmas party, and will celebrate the 10th anniversary of the founding of the Hermanus Centre. See details on the front page regarding booking to attend.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month at 19.00. This month's meeting will take place on **4 December** at the **Catholic Hall**, starting at **19.00**. Attendees will watch the next two episodes in the DVD series: Particle Physics for Non-Physicists: a Tour of the Microcosmos' by by Prof Steven Pollock, Professor of physics at the University of Colorado at Boulder. The content will be Lecture 21: 'Back to the future 1 – experiments to come' and Lecture 22: Back to the future 2 – puzzles and progress'.

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 will be no meeting in December. The next meeting is on **15 January**.

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, in the new year, to take and process images themselves.

For further information on both the MONET and Las Cumbres projects, please contact Deon Krige at deonk@telkomsa.net

FUTURE ACTIVITIES

No trips are being planned, at present.

2017 MONTHLY MEETINGS

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

11 Dec 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

This scorching exoplanet snows sunscreen 2 November: You do not need to pack sunscreen on Kepler-13Ab.because it is one of the hottest known exoplanets at 5,000°F, and you would be fried just going near it. Also, because that intense heat from its parent star interacts with the planet in such a way that it snows titanium oxide. That is the same stuff that gives UV protection on a summer day. Powerful winds blow the chemical around the atmosphere, where it falls in flakes to its nether levels on the planet's cooler nightside. The Hubble Space Telescope confirmed this phenomenon by taking spectra of the system during a planetary transit of its parent star.

Kepler-13Ab, shown left, is tidally locked to its sun, Kepler-13A. NASA / ESA / G. Bacon (STScI)

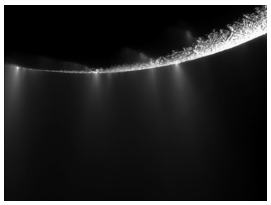
Kepler-13Ab is an odd one. It has an orbital period of 1.8 days, one of the shortest of the known exoplanets, and is estimated to be about six times the mass of Jupiter and has about 1.5 times Jupiter's radius. It is the sole known planet in a triple star system, where two stars orbit each other and a third, smaller-mass companion orbits one of the larger stars.

By: John Wenz

Why is Enceladus not frozen already? 7 November: During its voyage around the ringed planet from 2004 to 2017, the Cassini spacecraft observed a surprising amount of geological activity on Saturn's sixth largest moon, Enceladus. Cassini found that the frigid world not only has a vast global ocean lurking beneath its thick, icy shell, but also scores of geysers that routinely erupt from fissures in its surface, blasting plumes of mineral-laden water vapour into space at speeds of over 800 miles per hour. However, the driving force behind this geologic activity has long been a mystery.

Despite being only about as wide as Arizona, Enceladus is one of the brightest objects in the solar system. Since its ice-covered surface reflects almost 100% of incoming sunlight, the surface of Enceladus is also extremely cold, hovering around -201°Celsius. Given its tiny size, icy crust, and frigid temperatures, one would expect that Enceladus would have cooled rapidly after its formation, freezing solid long ago. However, this is apparently not the case.

How is Enceladus still so geologically active when its similarly sized neighbour, Mimas, seems to be completely frozen and dead? Should the ocean beneath Enceladus' icy crust not have frozen solid billions of years ago? These questions, which have puzzled astronomers and planetary geologists for the past decade, may have finally been answered. In the study, researchers presented the first computer model of Enceladus that not only replicates all of the moon's fundamental characteristics as seen by Cassini, but also demonstrates an effective heating mechanism by which Enceladus could maintain its subsurface liquid ocean for billions of years.


Plumes of water ice can be seen spraying from crevasses near the south pole of Saturn's moon Enceladus. More than 30 jets of different sizes were captured in this image taken as the Cassini spacecraft flew through the jets in 2009. NASA/JPL/Space Science Institute

"Where Enceladus gets the sustained power to remain active has always been a bit of a mystery," says lead author Gaël Choblet from the University of Nantes in France, "but we've now considered in greater detail how the structure and composition of the moon's rocky core could play a key role in generating the necessary energy." For years, researchers have suggested that tidal forces - gravitational pushes and pulls - acting on the surfaces of ice-covered moons could generate enough heat to maintain subsurface oceans. However, prior research has shown that if only the icy crust of Enceladus were flexing due to its tidal tug-of-war with Saturn and its fellow moons, then there would only be enough heat generated to maintain its ocean for about 30 million years.

The researchers' key insight came when they stopped assuming Enceladus had a solid rocky core and instead considered the possibility of a porous core containing 20 to 30 percent empty space. When they did this, their model showed that as Enceladus orbits its parent planet, tidal forces from Saturn easily flex Enceladus' porous core, causing the rocks to grind together, generating massive amounts of heat from friction. Since this heat is generated within the core of Enceladus, it remains somewhat insulated and tends to build up over time. Also, because the moon's porous core is semipermeable, water also

trickles down from the ocean into the rock below. Here, energy from the hot, rocky core is transferred to the water, heating it to at least 90°Celsius.

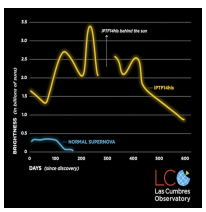
This causes the water to well upward and outward, which creates hotspots on Enceladus' ocean floor. The researchers' simulation showed that one of these sea floor hotspots alone was capable of releasing about five gigawatts of energy. For comparison, Hoover Dam is capable of producing just over two gigawatts. Furthermore, the model showed that this global water heater should be strongest near the moon's poles, where warm, mineral-rich water rises from the sea floor to the icy outer shell. Over time, this subsurface heating mechanism has thinned Enceladus' frozen crust to just a few kilometres thick at the south pole - where the moon's geysers are located. Meanwhile, the rest of Enceladus' outer shell remains about 20 to 25 km thick.

Considering where life on Earth is believed to have formed, one of the obvious questions that comes along with this study is: Could life exist near Enceladus's hot, mineral-rich hydrothermal vents? And if so, how do we study these sites? According to Nicolas Altobelli, ESA's Cassini project scientist, "Future missions capable of analysing the organic molecules in the Enceladus plume with a higher accuracy than Cassini would be able to tell us if sustained hydrothermal conditions could have allowed life to emerge."

NASA recently announced that they have plans to build the Submillimeter Enceladus Life Fundamentals Instrument (SELFI), an instrument that will "study the composition of geysers spewing water vapor and icy particles from the south pole of Saturn's small moon, Enceladus." By measuring trace chemicals in the water plumes, scientists believe they can determine the composition Enceladus' subsurface ocean, shedding light on the potential of the small, cold moon to host extraterrestrial life. By: Jake Parks

What is dead may never die 8 November: When a massive star blows itself up, it should remain dead. This is something astronomers have witnessed thousands of times before with absolutely no exceptions. That is, until now. For the first time, astronomers have discovered a star that has gone supernova more than once. This so-called 'zombie star' - which exploded at least twice in the last 60 years alone - has baffled scientists by challenging many of the existing theories about how massive stars end their lives. "This supernova breaks everything we thought we knew about how they work," said the study's lead author Iair Arcavi, a NASA Einstein Postdoctoral Fellow at the University of California-Santa Barbara and Las Cumbres Observatory. "It's the biggest puzzle I've encountered in almost a decade of studying stellar explosions."

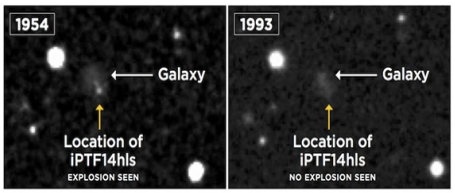
The undying star, named iPTF14hls, was first discovered in September 2014 by the Palomar Transient Factory (PTF), a fully automated, wide-field survey designed to spot cosmic objects that vary in brightness over time - such as variable stars, transient objects, and, of course, supernovae.



Over the course of two years, iPTF14hls grew and dropped in brightness at least five times. Most supernovae are bright for +/-100 days before fading for good. LCO/S. Wilkinson

When the international team of astronomers first spotted the explosion, a spectral analysis indicated it was just a run-of-the-mill, Type II-P supernova whose brightness would likely fade after about 100 days. Supernova iPTF14hls, on the other hand, had a different plan. Although it initially faded after its 2014 explosion, within a few months it began to mysteriously grow brighter again. Over the course of three years, iPTF14hls fluctuated between bright and dim at least five separate times. "This [was] one of those head-scratcher type of events," said co-author Peter Nugent, a senior scientist at Lawrence Berkeley National Laboratory. "At first we thought it was completely normal and boring. Then it just kept staying bright, and not changing, for month after month."

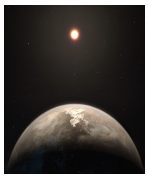
When the astronomers realized iPTF14hls was not an average supernova, they decided to go back and search through archival data. They were flabbergasted when they found that in 1954, another explosion was recorded in the exact same location as iPTF14hls. Somehow, the star survived its first explosion, waited 60 years, and then exploded again.



Palomar Observatory Sky Survey image reveals a possible 1954 explosion at iPTF14hls location, not seen in later 1993 image. POSS/ DSS/ LCO/S. Wilkinson

Although researchers are still uncertain what caused iPTF14hls to go supernova twice, one theory is that the 'zombie star' is actually a 'pulsation pair instability supernova'. "According to this theory, it is possible that this was the result of a star so massive and hot that it generated antimatter in its core," said co-author Daniel Kasen, a professor of physics and astronomy at the University of California-Berkeley. "That would cause the star to go violently unstable, and undergo repeated bright eruptions over periods of years." The authors of the study calculated that before the first explosion, the star was at least 50 times as massive as the Sun (and likely larger). "These explosions were only expected to be seen in the early universe and should be extinct today," said co-author Andy Howell, leader of the LCO supernova group. "This is like finding a dinosaur still alive today. If you found one, you would question whether it truly was a dinosaur." By: Jake Parks

A potentially habitable planet has been discovered just 11 light-years away 15 November: Our local planetary neighbourhood just got a new neighbour - and it may be a good place to find some vital signs. Just 11 light-years away, a sleepy red dwarf star named Ross 128 has at least one planet orbiting it. Ross-128b is roughly the size of Earth, and a little more massive. Despite a year that lasts a hair under 10 days, it may also be the nearest place to find life near Earth.


Ross 128b is a possibly temperate, Earth-sized world circling a red dwarf just 11 light-years from Earth. ESO/M. Kornmesser

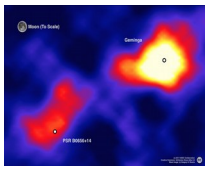
Only one confirmed exoplanet is closer to us, Proxima Centauri b. However, Proxima Centauri, despite its similar size and mass to Ross 128, has one key difference: it is an

active star, continuously cooking its known planetary system with scorching radiation that may have blasted away any chance of Proxima b having an atmosphere, and hence, life.

In contrast, Ross 128 is an older star, and significantly more quiet. In fact, stellar activity there is fairly rare compared to other M-dwarfs. There are a lot of "ifs', but if Ross 128b has an atmosphere, it may not have trouble holding onto it, unlike Proxima b. And if that atmosphere has a greenhouse effect, it could heat the planet up to around 21°Celsius. One caveat: Ross 128b is likely tidally locked to its parent star, and scientists aren't sure how this affects habitability as one side is always facing the star and one side is always facing away. The planet was discovered by the High Accuracy Radial velocity Planet Searcher (HARPS) instrument at the European Southern Observatory after several years of measurements.

As Jason Davis at the Planetary Society points out, there is something else interesting about Ross 128 ,as well. The Breakthrough Listen program, the most robust Search for Extraterrestrial Intelligence (SETI) campaign of all time, found some strange rumblings from the direction of Ross 128. While the signal has since been ruled out as likely interference from Earth-orbiting satellites, this discovery gives SETI researchers a chance to look again and eavesdrop in. So, welcome our new neighbour, Ross 128b. And wave "hi" to it in 79,000 years, when it will become the closest planetary system to Earth, thanks to the motions of our Sun and neighbouring stars as they orbit the centre of the Milky Way. By: John Wenz

New pulsar result supports particle dark matter 16 November: New results from an unconventional observatory in Mexico are bringing scientists one step closer to solving the dark matter mystery. They lend credence to the idea that some strange non-light-emitting particle is responsible for about 85% of the universe's mass. This new observation casts serious doubt on the more conventional of two favoured theories for the enigmatic excess of antimatter particles in space, leaving dark matter particles as the most likely explanation.



Gamma rays from the Geminga and PSR B0656+14 pulsars cannot account for the positron excess measured by satellites in Earth orbit. Courtesy Miguel Mostafa (Penn State)

The origin of this mystery dates back to 2008, when the European PAMELA satellite first registered an unexpectedly high number of positrons in near-Earth space. Positrons can be thought of as positively charged electrons, or the antimatter counterparts to electrons. More recently, the Alpha Magnetic Spectrometer (AMS) experiment aboard the International Space Station has extended PAMELA's finding, seeing roughly three to five times more positrons than scientists predicted.

Theorists came up with two logical explanations for the excess positrons. The more prosaic explanation says that rapidly rotating neutron stars (pulsars) are violently throwing off positrons and other subatomic particles, some of which make their way to Earth. However, other scientists proposed a more exotic alternative: that very heavy dark matter particles pervading our galaxy mutually annihilate one another whenever they come into

close proximity, self-destructing into a cascade of positrons and other elementary particles.

To test the pulsar hypothesis, an international team of scientists observed the sky with the High-Altitude Water Cherenkov (HAWC) Observatory. This is not an ordinary observatory with one or more astronomical telescopes. HAWC instead consists of 300 large water tanks stationed at an altitude of 13,500 feet in the southern Mexican state of Puebla.

The HAWC observatory consists of 300 tanks full of water, designed to detect Cherenkov radiation. AnaDiBec

HAWC indirectly picks up very-high-energy gamma rays, the highest-energy form of 'light' yet detected in the universe. Each of these gamma rays packs the punch of roughly 10 million dental X-rays. When one of these gamma rays slams into an atom in Earth's upper atmosphere, it smashes it apart into a shower of secondary particles that rain downward at near-light speed. These minuscule packets of energy pass through HAWC's water tanks, producing simultaneous flashes of blue light known as Cherenkov radiation after Russian physicist Pavel Cherenkov, who co-discovered this bizarre form of light in 1934.

During observations taken from November 2014 to June 2016, HAWC clearly detected very high-energy gamma rays from the region around two relatively nearby pulsars in Gemini. The pulsars, known as Geminga and PSR B0656+14, are roughly 800 and 900 light-years away, respectively. Detecting such high-energy gamma rays from an extended region around these pulsars was itself a first, made possible by HAWC's wide field of view. The problem, says team member Miguel Mostafá of Penn State University, is that "the observed flux of gamma rays is not enough to account for the positron excess."

Each pulsar throws off positrons and electrons, which interact with surrounding photons from the early universe (the cosmic microwave background) to produce gamma rays in an extended region. Unfortunately, scientists cannot trace positrons around Earth back to their point of origin. Because positrons are electrically charged particles, they are deflected by magnetic fields permeating space, meaning they don't come straight toward us. So HAWC measured the radial extent of gamma-ray emission from each pulsar, which is an indirect measurement of how many positrons are being produced and how fast these particles are moving away from their host pulsar.

"The gamma rays that we measure are a tracer for the electrons and positrons near the source. Using this, we can map out how fast the electrons and positrons are moving away from the source. Knowing the age and the distance of the pulsars, we can figure out if they can get here," says HAWC principal investigator and U.S. spokesperson Jordan Goodman of the University of Maryland.

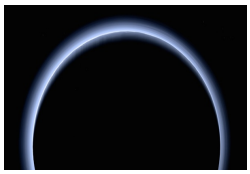
Putting this all together, the team concludes that the pulsars are not producing anywhere near enough positrons to explain the excess observed by PAMELA and AMS. Because the two pulsars are among the closest to Earth, it seems very clear that pulsars in general cannot account for the anomaly. So, if pulsars cannot explain the positron excess, what

can? Some theorists have proposed supernova remnants and black hole jets. HAWC has detected these types of objects, but as Goodman explains, "Most are too far away and too young to send particles all the way to Earth."

This leaves dark matter particle annihilation as the most likely explanation for the positron excess. This theory has been on the books for many years, and it's not contradicted by any astronomical observations. Physicists have proposed a number of different types of dark matter particles, with a wide range of properties and masses. If annihilating dark matter is indeed responsible for the positron excess, the particles themselves would have whopping masses of about a thousand protons - approximately the mass of four or five uranium atoms. Experiments at the Large Hadron Collider in Switzerland and in underground laboratories around the world have yet to turn up direct evidence for dark matter particles. So, although HAWC seems to have ruled out pulsars as the source of the excess positrons, their origin remains a mystery, as does the nature of dark matter.

By: Robert Naeye

Pluto's smog keeps it cool 17 November: The dwarf planet Pluto averages a distance of nearly 40 astronomical units from the Sun, or 40 times the distance between Earth and the Sun. That vast distance from our heat-giving star is responsible for some pretty frigid temperatures on the small world, but, apparently, its atmosphere also feels the need to make a contribution. Recent research now suggests that the hazy smog that envelops Pluto is responsible for further cooling, dropping the temperature of the atmosphere to a mere 70°Celsius above absolute zero.



Pluto's blue haze can be seen in crisp detail in this image taken by New Horizons as it left the tiny world behind. NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute°

The research set out to investigate New Horizons' 2015 finding that Pluto's atmosphere was 30°C colder than expected. The disparity confounded planetary scientists, whose goal is to not only learn more about the atmosphere and weather on Pluto, but also to use that information to extrapolate conditions on other icy, distant solar system objects. This new research, led by Xi Zhang at the University of California, Santa Cruz, found that models taking into account the thick haze surrounding Pluto best matched the temperature data taken by the spacecraft, showing the importance of the haze for cooling the atmosphere.

The haze is created when sunlight interacts with the upper layers of Pluto's atmosphere, which is largely nitrogen with small amounts of other compounds, such methane. Because the haze particles are much larger than the other molecules in the atmosphere, they heat and cool the atmosphere differently and are ultimately responsible for cooler temperatures than otherwise expected. However, because the haze does not block light, it was not considered important for heating or cooling in the atmosphere prior to this study.

Smog-induced cooling is still not the only idea on the table for Pluto's chilly weather. One alternative solution calls on atmospheric gases such as hydrogen cyanide, acetylene, and ethane to induce extra cooling instead. According to Zhang, the best way to determine the true culprit is to observe Pluto in mid-infrared light - if the haze plays an important role in

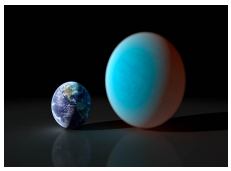
cooling the atmosphere, it should look bright at these wavelengths. Once the James Webb Space Telescope is launched in 2019, Zhang hopes to make such an observation to confirm or rule out his team's theory. By: Alison Klesman

Did life hitchhike through the Solar System? 21 November: Astronomers have long believed that asteroid (or comet) impacts were the only natural way to transport life between planets. However, a new study, led by Professor Arjun Berera from the University of Edinburgh's School of Physics and Astronomy, suggests that life on Earth might have begun when fast-moving streams of space dust carried microscopic organisms to our planet. Berera found that these streams of interplanetary dust are not only capable of transporting particles to Earth, but, also, from it.

Interplanetary dust - a combination of debris from ancient asteroid collisions, active comets, and interstellar dust - is pervasive throughout the solar system. Roughly 100,000 kilograms of space dust fall onto Earth every day. Also, in interplanetary space, streams of cosmic dust can travel together at speeds of up to 70 kilometres per second. The researchers found that, as these streams of dust graze Earth, they collide with organic particles found in the upper atmosphere. These small particles, which are trapped about 150 kilometres, or higher, in Earth's atmosphere, are then knocked out with enough force to escape Earth's gravity altogether. Once the particles are free from the bounds of Earth, the powerful dust flows can pick up and carry the microscopic hitchhikers off through interplanetary space.

Since some bacteria, plants, and even small animals - known as tardigrades - can survive in space, it is possible that these organisms could also get caught in the dust conveyor belt and hitch a ride to another planet. The same mechanism outlined in the study also allows for distant planets within the same solar system to exchange atmospheric particles with one another. "The proposition that space dust collisions could propel organisms over enormous distances between planets raises some exciting prospects of how life and the atmospheres of planets originated," said Berera. "The streaming of fast space dust is found throughout planetary systems and could be a common factor in proliferating life."
By: Jake Parks

Planetary scientists close in on a super-Earth with an Earth-like atmosphere 21 November: 55 Cancri e may have an oddly familiar atmosphere, but do not get your hopes up. The super-Earth appears to have an atmosphere dominated by hydrogen, nitrogen, and oxygen, much like Earth. However, it completes an entire year in just 18 hours and has a day side that reaches 2,300° Celsius.


55 Cancri e (right) is a super-Earth twice our planet's size circling a star about 40 light-years away. NASA/JPL-Caltech/R. Hurt (SSC)

The evidence comes from the Spitzer Space Telescope, which witnessed several transits of the hot, hot planet. By looking at variations in the infrared emissions from the planet, astronomers deduced that the temperature ranges could only be explained by the presence of an atmosphere. The 'cold' side, which never faces the parent star due to tidal locking, still reaches 1,300 to 1,400 degrees Celsius, meaning something is transporting

heat from the day to the night side. That something was once thought to be lava, which was envisioned to encase the planet. However, lava would move the heat too slowly, and now astronomers believe that 'something' is a thick atmosphere.

Still, researchers had not expected to see any atmosphere around a planet so (relatively) small so close in to its star. Mercury, the closest-in planet in our solar system, has only a tentative atmosphere that must be continually renewed as it is barraged with particles. Further studies should be able to draw out more details of its atmosphere and find out how it managed to cling onto it for dear life. By: John Wenz

The first discovered interstellar asteroid is a quarter-mile long red beast 22 November: The first discovered interstellar asteroid to come through our solar system has quite an unusual shape. 1I/2017 U1, which has since been named `Oumuamua, swept past Earth last month. Its bizarre trajectory seemed to indicate that it was not in orbit around the Sun; it came from nowhere and it was headed back out to parts unknown.


The interstellar asteroid `Oumuamua. ESO/M. Kornmesser

Observations from the European Southern Observatory's Very Large Telescope revealed that the asteroid is an oblong, reddish, solid chunk of rock or metal. Initially identified as a comet, it has since given no indication of a tail and has been officially reclassified as an interstellar asteroid. It is 10 times longer than it is wide, and is nearly 400 metres long. It came from the same region of the sky now occupied by Vega, but that star was in a different position 300,000 years ago when this asteroid would have passed through the region. We may never know quite where it came from.

The oddball interstellar asteroid is the first of its kind discovered. Asteroids are relatively small, dark objects that require careful observation and sensitive instrument to detect, especially if they're moving as fast as `Oumuamua. But surveys like Pan-STARRS, which spotted the interloper, may be able to detect other objects like it and help us study more rocks that are just passing through. By: John Wenz

Astronomers measure the motions of stars in a nearby galaxy 28 November: When you look up at the night sky, the stars appear fixed — but ,things are not as they appear. In fact, every star in our galaxy is moving. While it is easy for astronomers to measure whether a star is moving toward or away from us, it is much harder to measure a star's motion in the plane of the sky, or side to side. This is because the stars are so very distant, it takes years for even the most minute change to become visible. It is why the constellations have appeared essentially the same over time; but given enough time, they will eventually warp and change as the motion of the stars that make them up becomes apparent.


The Sculptor dwarf galaxy is a satellite of the Milky Way, appearing here as a faint "cloud" of stars. ESO

This 'sideways' motion, called proper motion, has only ever been measured for stars in the Milky Way - until now. Recently, a group of astronomers combined data from the Hubble Space Telescope and the European Gaia mission to measure the proper motions of several stars in the Sculptor dwarf galaxy, a small, nearby satellite of the Milky Way. Their work now presents a possible challenge to the standard models of dark matter haloes believed to surround galaxies such as our own.

The Gaia mission measures the positions of stars very precisely. While most of these stars are in the Milky Way, its targets do include some stars in nearby galaxies, such as the Sculptor dwarf. The Hubble Space Telescope has also observed some of these same stars, measuring their positions 12 years ago. Davide Massari of the University of Groningen and colleagues at the Kapteyn Astronomical Institute were able to combine the Gaia and Hubble data - no easy feat, as the two measure position differently - to find that 15 stars could be accurately tracked between the two epochs.

"We determined how the stars move in this small galaxy," Massari explained. "But, our measured value was very surprising, as the standard models didn't allow it." Those standard models describe the expected distribution of dark matter in a huge halo around the Milky Way, inside which the Sculptor dwarf is embedded. That dark matter should dictate how the stars move; disagreement could mean the models are wrong and need updating.

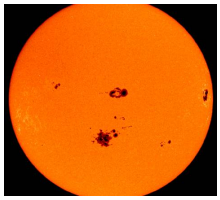
However, there is another explanation for the stars' seemingly strange motions. "The models assume all stars to be in a single population of stars," Massari said. However, the Sculptor galaxy has at least two known populations of stars, one more compact and one more extended. The stars in each population experience different impacts from dark matter. If the stars measured in the study all belong to the compact population, it would explain why their motions disagree with the dark matter models, preserving those models with no need for alteration.

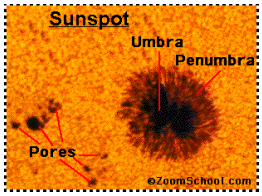
In addition to measuring the motions of stars inside the Sculptor dwarf, the team also improved measurements of the galaxy's orbit around the Milky Way. "This orbit is much wider than expected," said Massari. "Previously, it was believed that the current spheroidal shape of Sculptor was in part the result of some close passages, but our measurements show that this is not the case." As more Gaia measurements come in, this infor- mation will help us form a better picture of the galaxy we live in and the behaviour of those around us, including the influence of invisible dark matter. By: Alison Klesman

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

DID YOU KNOW?

The Sun Part 21: **Sunspots**





These appear visibly as dark spots on the Sun's surface. They correspond to concentrations of magnetic field flux that inhibit convection, resulting in reduced surface temperatures compared with the surrounding photosphere. They usually appear in pairs, each member having opposite polarity.

Sunspot numbers are closely linked with the 11-year solar (sunspot) cycle and vary in number as the cycles progress. Their position also varies across the cycle. Early in cycle, sunspots appear at higher latitudes then move towards the equator as solar maximum approaches. The polarity of each of the magnetic field in each pair also changes with each 11-year cycle from North-South to South-North and back. Spots from two adjacent cycles, distinguished by the direction of their magnetic field can co-exist for some time.

Although magnetic pressure should tend to counter field concentrations, causing sunspots to disperse, they can live from a few days to several months. The largest spots usually last the longest. Satellite observations may provide an explanation for why sunspots are not shortlived. A powerful downdraft identified beneath each sunspot forms a rotating vortex that is believed to sustain the concentrated magnetic field. However, all eventually decay. Moving with the rotating Sun, they can travel at relative speeds of a few 100 m/s. Many expand and contract as the move across the Sun's surface, with sizes ranging from small pores of around 300 km to groups spanning up to 160,000 km diameters. They usually appear in groups.

Reflecting intense solar magnetic activity, sunspots often accompany secondary phenomena eg coronal loops. Most solar flares and coronal mass ejections also originate in magnetically active regions around visible sunspot groupings

Sunspot temperatures vary from 3,000-4,500 K. With surrounding surface temperatures of around 5,700 K, these cooler areas are visible as dark spots. They have two parts. In the darker central umbra, the magnetic field lines are almost vertical to the solar surface and temperatures are as much as 1,600 K lower than the photosphere. In the lighter, outer penumbra, lines are more angled and temperatures are around 500 K cooler. The penumbra accounts for around 70% of a spot's area.

They are self-perpetuating storms, apparently the visible counterparts of magnetic flux tubes in the convective zone which get 'wound-up' by the differential rotation of the Sun. If stress on tubes reaches a certain limit, they curl up and punctuate the Sun's surface. Because convection is inhibited at the puncture points, energy flux from the interior falls, and, with it, surface temperatures. All sunspots start as tiny dark pores and then may develop into small penumbra-less spots arranged in pairs. In a developing group, the spots become much larger and more separated in the first few days, reaching maximum complexity and area by the tenth day.

Monitoring sunspot numbers is central to study of solar activity. Initially introduced in 1848 by Swiss astronomer Rudolph Wolf, the so-called Wolf sunspot number system was replaced in 1855 by the more refined relative sunspot number. This is calculated by

accounting for both the total number of individual spots and number of sunspot groups plus a factor k which represents the efficiency of the observer and telescope. In 1981, responsibility for generating the sunspot numbers during specific intervals was transferred from Switzerland to the Royal Observatory in Brussels. At this time, the index was renamed the International Sunspot Number. In America, two other sunspot number indices are also compiled.

Since the start of satellite measurements in 1979, sunspot numbers have been found to correlate with the intensity of solar radiation. Variations in solar intensity caused by the sunspot cycle are relatively small; around 0.1% of the solar constant.

Observation history The sunspots recorded during the Han dynasty in China (206 BCE – 220 CE) are possibly the earliest written records of these solar features. During the 12th century, the Arabic philosopher Averroes also described sunspots.

However, it was during the early 17th century that the development of the telescope allowed for improved understanding of sunspots. Galileo is the most famous person to observe sunspots through a telescope, but Thomas Hariot and others also made early telescopic observations. Galileo posited that the dark marks were on the surface of the Sun, not small objects passing between Earth and Sun, as had been proposed earlier. During the 1860s, the English solar physicist Norman Lockyer was first to study sunspots spectroscopically. He found Doppler shifts caused by convection currents in the Sun's gases.

Sunspots continue to be observed with both land-based and Earth-orbiting solar telescopes. Filtration and projection techniques are used on telescopes to allow for direct observation and camera imaging. Other specialised tools, including spectroscopes and spectrohelioscopes, are also used to study sunspots. Also, use of artificial eclipses which block the central body of the Sun, allow for viewing of the solar edge and circumference as sunspots rotate through the horizon.

Due to its association with other solar activity, recording sunspot occurrence and behaviour can help predict space weather, the state of the ionosphere and conditions for shortwave radio propagation and satellite communication

Sources: Ridpath, I (Ed) 2012 Oxford dictionary of astronomy 2nd ed rev, 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, observatory, youth club)	028 314 0830
Laura Norris (Treasurer)	028 316 4453
Peter Harvey (Secretary, monthly sky maps)	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
John Saunders (Guest speakers and events)	028 316 2302
Non-committee members with roles:	
Pierre Hugo (Cosmology interest group)	028 312 1639
Johan Retief (Hawston School Youth Club)	028 315 1132