"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

AUGUST 2016

This month's Centre meeting – on a different day
This takes place on **Thursday 18 August** at **SANSA** starting at t **19.00**. HAC and SANSA are co-hosting a talk by Kevin Govender, Director of the IAU's Office for Astronomy Development, based at the SAAO in Cape Town. See further details below.

Stargazing
Weather permitting, the next event is scheduled for **Friday 5 August** at the **NG Kerk, Berg Street, Onrus**, The focus will be on observing 'The Big Five of the African Sky' (see below for more details). Further details, including time, will be circulated soon.

WHAT'S UP?

Jupiter, Venus and Mercury trio Throughout this month, three planets participate in a trio which brings them closer and closer together as the days pass. The gas giant Jupiter, second brightest of the planets, begins the dance highest in the sky. Over time, it appears to move towards the horizon. The brightest planet is also part of the trio. Venus's thick atmosphere of white clouds, consisting mostly of carbon dioxide, reflects much of the sunlight reaching it. This makes it easy to locate towards the west after sunset, at first close to the horizon, but, over time, moving upwards towards descending Jupiter. Mercury's position is between the other two, its path almost horizontal as the other two planets appear to move towards it. Smallest of the planets, Mercury is the most difficult of the three to spot. During the last days of August, the three planets are closely positioned, their relative positions altering as their paths begin to separate.

LAST MONTH'S ACTIVITIES

Monthly centre meeting On 18 July, Case Rijsdijk from the Garden Route Centre, gave an engrossing presentation which asked the question 'Are we alone?'. After defining what is meant by 'life' and summarising the history of the search for extraterrestrial life, he listed the conditions needed for life to exist on other planets eg water, an atmosphere etc. Using the concept of the 'habitable zone', Case then summarised the apparent nature of the thousands of exoplanets which have already been identified by the Kepler spacecraft. These findings have identified that, in several ways, our solar system is not typical of others. While emphasising that scientists are still in the early stages of searching for evidence of possible life on other planets eg carbon based gases in the atmosphere and that there is a long way to go until we can know with any certainty, Case concluded that the answer to his question is that it is very likely that there is other life out there.

Interest groups

Cosmology Seventeen people (15 members, 2 visitors) attended the meeting on 4 July. They viewed the eleventh pair of episodes of the 24 part DVD series on Time, given by Prof Sean Carroll from CalTech. The topics were: Lecture 21: 'Evolution of the Universe' and Lecture 22: 'The Big Bang'.

Astro-photography Five people attended the meeting on 11 July. They agreed on targets for photography, which they will undertake during the coming weeks.

Other activities

True scale solar system model inauguration At a formal event held at the Municipal Auditorium on 19 July, the Mayor formally inaugurated the new model, which has been installed along the cliff path, from the amphitheatre to Grotto Beach. Both she and Pierre de Villiers thanked all those who were involved in this project including Ward 3 committee for agreeing to fund it, Overstrand Municipality and the Cliff Path Management Group for agreeing that it be installed on land for which they are responsible, SAAO for producing the planet models, the Lukhanyo and Hawston youth groups who painted the smaller planet models, SANSA for producing the Sun model, several local professionals and tradespeople who were involved in the siting, construction and erection of the models and their associated explanatory details, and members of the HAC committee who helped ensure the accuracy of information provided and assisted with the fine details of completion of the models and their erection. The Mayor also recognised the huge, central role played by Pierre de Villiers in the initiation and execution of this complex project. Afterwards, at the Sun model, at the amphitheatre, the Mayor formally untied the ribbon.

Stargazing Forecasts of cloud meant that the event scheduled for 29 July was cancelled.

Educational outreach

Hawston Secondary School Astronomy Group Case Rijsdijk led a workshop for the Space Cadets on 19 July.

Lukhanyo Youth Club Case Rijsdijk led a workshop for the learners on 18 July.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This will take place on **Thursday 18 August** at **SANSA** at **19.00.** The presentation by Kevin Govender will be co-hosted by SANSA and HAC. Kevin began work at the OAD (Office of Astronomy for Development) in 2011 as its first Director. He has extensive experience in using astronomy for development during his previous position as the Manager of the SALT Collateral Benefits Programme at the South African Astronomical Observatory. He also chaired the Developing Astronomy Globally Cornerstone Project of the International Year of Astronomy (IYA2009) and was involved in the development of the IAU Strategic Plan.

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. This month's meeting will take place on **1 August** at the Scout Hall. Attendees will view the final pair of episodes of the new DVD series on Time by Prof Sean Carroll from CalTech. Topics for this month are: Lecture 23: 'The Multiverse' and Lecture 24: 'Approaches to the arrow of time'.

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 third Monday of each month. There is no meeting in August. The next meeting will take place on **12 September.**

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

Stargazing The next event is scheduled for **Friday 5 August** in the grounds of the **NG Kerk, Onrus.** Time and further details will be circulated to members in due course. The focus will be on observing the 'Big Five of the African Sky'. This project, developed by ASSA, highlights the five types of deep sky objects: a galaxy, a bright nebula, a dark nebula, an open cluster and a globular cluster. Wonderful examples of these are visible in the winter night sky and attendees will have the opportunity to record their observations. Confirmation of the date, time and venue for the event will be circulated to members closer to the time, once weather conditions can be predicted.

Hermanus Youth Robotic Telescope Interest Group Technology permitting, organisers are hoping to start working with learners during the coming school term.

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

FUTURE ACTIVITIES

Logistical issues at possible locations mean that, unfortunately, no events are being planned for 2016.

2016 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month at the Scout Hall beginning at 19.00. Details for 2016 are:

19 Sept	'100 years of relativity – the next chapter'. Presenter: Prof Bruce Bassett, UCT and AIMS
17 Oct	'Dark skies: the unseen Universe". Presenter: Jenny Morris, Committee member
21 Nov	'Science we have learned from space telescopes'. Presenter, Pierre de Villiers, Chairman, HAC committee
12 Dec	Xmas party

ASTRONOMY EDUCATION CENTRE AND AMPHITHEATRE (AECA)

Committee members are currently compiling formal responses to objections received by Overstrand Municipality for submission by 20 August. 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

Juno successfully enters orbit around Jupiter 4 July: NASA's Jupiter probe, Juno, has entered orbit around the gas giant after a 35 minute burn to decelerate the craft, which was headed toward Jupiter at 215,000 kph. The burn was make-it-or-break-it. Had it not gone according to plan, the craft might have flown right past the planet. Now, it will work from a 53 day orbit into a 14 day orbit, making 37 passes over 20 months in an effort to understand the interior of the largest planet in our solar system.

In that time, the craft will repeatedly put itself on the line in Jupiter's intense radiation. Some instruments, including the Juno cam, may not make the entire journey. In the end, though, we may be able to tell if Jupiter formed closer to the sun (like so called 'Hot Jupiters') and migrated out or formed closer to its present location. By: John Wenz

Phobos and Deimos may harbour clues to Mars' violent past 5 July: For years astronomers have been trying to determine the origin of Mars' moons, Phobos and Deimos. The long standing argument that they were captured asteroids may fall by the wayside in lieu of a new theory. A new theory introduces the idea that Mars' two moons, Phobos and Deimos, were created after an intense Martian collision.

An artist's interpretation of the collision between Mars and a primordial object that could have created Phobos and Deimos as well as the Borealis basin

The biggest factor working against the asteroid theory is that the shape and trajectory of both moon's orbits contradict it, but two new studies show that they might have been created from a giant collision. Researchers from the National Centre for Scientific Research (CNRS) and Aix-Marseille Université have determined that the only scenario consistent with their surface properties is that of a huge collision, while Belgian, French, and Japanese researchers in the second study used digital simulations to show this collision.

The second study states that 100 to 800 million years after Mars' formation, there was a collision between it and a small planet one-third Mars' size. The debris from the impact would have generated a wide disk around the planet with the dense molten lava towards the inner part and the gaseous remnants around the outer part. A very large object about 10 times the size of Phobos was created by the inner part of the disk which then acted as a gravitational catalyst for the outer disk to form into much smaller objects. After a few thousand years, approximately 10 smaller moons and one bigger moon surrounded Mars. Once the debris disk disappeared a few million years later, Mars' tidal effects brought all but two small moons crashing back onto the planet. The two remaining moons are Phobos and Deimos. Phobos itself is still in a downward spiral toward Mars.

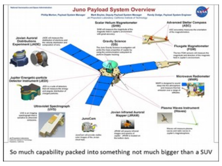
As no one digital simulation can model the entire process, three simulations had to be combined in order to account for all the physics behind the collision. This included the dynamics of the debris disk, it formation into the satellites, and their long-term evolution.

In the first study, the asteroid theory was ruled out based solely on the compositional diversity of the asteroid belt. The light signatures emitted by both Phobos and Deimos determine that they could not have been created from the primordial matter that created Mars (meteorites such as ordinary chondrite). The light signature shows the satellites are made of fine-grained dust. These small grains on the moon's surface cannot only be there due to interplanetary dust, so they must have been made up of very fine grains since the beginning. Phobos and Deimos could have only been created in the outer gaseous section of the debris disk and not the inner portion. Both studies are in agreement on this idea.

Japan's space agency (JAXA) will launch a mission in 2022 named the Mars Moons Exploration (MMX) that will bring back samples from Phobos in 2027. The European Space Agency (ESA) and the Russian space agency (Roscosmos) are working together to launch a similar mission in 2024, Phobos-Soil. These observations may make it possible to determine the age and composition of Mars' moons and help validate this hypothesis.

By: Jordan Rice

Here is how Juno will study Jupiter 5 July: Juno launched from Cape Canaveral, Florida on 5 August 2011 and reached Jupiter on 4 July 4th, 2016. Juno's mission is to study Jupiter by orbiting the planet 32 times during its life passing as close as 5,000 km to the upper-most layers. The spacecraft is equipped with 9 scientific instruments, all dedicated to studying the largest planet in the solar system.



Overview of Juno's science instruments and their placement on the spacecraft

As the spacecraft is in a polar orbit around the planet, this is the prime spot for studies into the gravitational and magnetic fields of Jupiter. Juno will precisely map the gravitational field to determine how the mass is distributed throughout the planet as well as properties of its structure. Juno will also map the magnetic field to try and determine its origin and structure as well as how far deep in the planet the field is created.

Another key part of the mission is to determine the ratio of oxygen to hydrogen in order to figure out how much water actually exists in the planet, which will hopefully give us insight into how the solar system was formed. Juno will also better estimate Jupiter's core mass to see how the planet formed in regards to the rest of the solar system.

Mapping every possible element of the cloud layers is also very important; such as mapping the temperature, opacity, composition, structure, and dynamics of the cloud layers at all latitudes. As Jupiter has a strong magnetic field, Juno is going to explore the 3-D structure of the magnetosphere and its accompanying auroras.

The nine instruments that will achieve Juno's science objectives are; the Microwave Radiometer (MWR), Jovian Infrared Auroral Mapper (JIRAM), Magnetometer (MAG), Gravity Science (GS), Jovian Auroral Distributions Experiment (JADE), Jovian Energetic Particle Detector Instrument (JEDI), Radio and Plasma Wave Sensor (Waves), Ultraviolet Imaging Spectrograph (UVS), and JunoCam (JCM).

The MWR has six antennas that will each pick up a certain wavelength in the microwave range; 600 MHz, 1.2 GHz, 2.4 GHz, 4.8 GHz, 9.6 GHz, and 22 GHz. These wavelengths correspond to the only microwaves that can escape Jupiter's thick atmosphere. The radiometer will me measuring the amount of ammonia and water in the deeper layers of the Jovian atmosphere at about 500 to 600 km. Combining the data from both of these devices, it is possible to get a temperature profile at different depths.

The JIRAM will conduct its studies to the upper layers at around 50 to 70 km deep. It will provide images of the aurora as well as see how the water and clouds are moving beneath the upper layers. JIRAM can also detect other important molecules like water vapour, methane, and phosphine.

There are two parts to the magnetometer, the Flux Gate Magnetometer (FGM) and the Advanced Stellar Compass (ASC). The FGM measures the strength and direction of the magnetic field lines while the ASC monitors the orientation of the FGM sensor. The magnetometer has a very important job as its data will be used to help map the magnetic field around Jupiter, reveal clues to the dynamics of the planet's interior, and make a 3-D structure of the polar magnetosphere.

The purpose of the GS is to study and map the distribution of mass inside the planet by using small variations in gravity in Jupiter's orbit. JADE's mission is to measure the energy and velocity vector of the low energy ions and electrons in Jupiter's aurora. While JEDI's mission is to measure the energy and velocity vector of the high energy ions and electrons in the polar magnetosphere. The Waves instrument will be surveying the plasma and radio spectra in the auroras to look at the acceleration of the particles in the aurora.

As the spacecraft is spinning, the UVS will be recording the wavelength and arrival time of the ultraviolet photons that pass through the instrument's slit as it turns toward and away from the planet. It will also provide ultraviolet images of the auroras. The final instrument aboard Juno is the JunoCam. This instrument is purely educational and designed for public outreach. JunoCam will only function for about seven orbits around the planet as the harsh radiation field's of Jupiter will slowly destroy it. It will take the first post-orbit photo around 27 August.

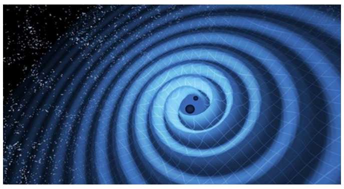
By: Jordan Rice

The world's largest radio telescope has just been completed 6 July: China's 30-soccer-field-wide radio telescope will start the hunt for extraterrestrials. ET may be easier to find now that China has just finished installation of the 4,450 triangular panels on the world's largest radio telescope, the Five Hundred Meter Aperture Spherical Telescope (FAST). The telescope was finished nearly three months ahead of schedule, with the original ETA in September. With its enormous size of 30 soccer fields, FAST has taken nearly five years and $180 million to build.


The world's largest radio telescope, FAST Xinhua

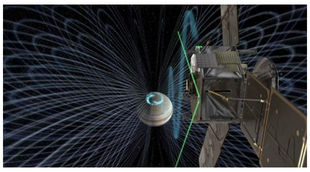
The next largest radio telescope is the 305-meter-wide Arecibo Telescope in Puerto Rico, which was completed in 1963. It has held the crown of largest radio telescope for 53 years. FAST is 64 percent larger. Nearly 9,000 residents within a five kilometre radius were relocated from their homes during FAST's construction and compensated 12,000 yuan or $1,800 from the Chinese government. FAST is tasked with many research projects involving studying strange objects such as quasars, pulsars, and gravitational waves, as well as searching for extraterrestrial life. By: Jordan Rice\

L**IGO looks forward to 1,000 black hole mergers per year** 8 July: Hot on the heels of the announcement of a second detection of gravity waves from merging black holes, scientists at the Laser Interferometer Gravitational wave Observatory (LIGO) say they expect to detect about 1,000 gravitational-wave events per year when the machine reaches its full design sensitivity by 2020.


This image shows an artist's impression of the original LIGO detection that lead to the confirmation of gravitational waves. LIGO/T. Pyle

To get an estimate of the number of binary black holes that have the potential to blast gravitational waves across the universe, the LIGO scientists went back to a basic model of the evolution of the universe. What came out of the model was a collection of binary stars of the right size and composition to collapse into binary black holes with the right properties to spiral in toward a collision and close enough to Earth to be detected by LIGO with its projected sensitivity. LIGO's installations in Hanford, Washington, and Livingston, Louisiana, are currently shut down for upgrades and are scheduled to begin observing again in September. The primary upgrade between now and 2020 will be to gradually step up the laser power, thereby increasing the detector's sensitivity. By: Allen Zeyher

Was Juno the fastest spacecraft ever? Only kind of. 12 July: Juno is the fastest spacecraft to enter orbit around another planet. But is it really the fastest spacecraft ever? When it comes to velocity, that depends on how you measure it.

 NASA-JPL

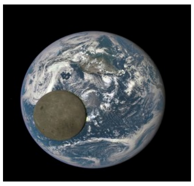
When the Juno spacecraft entered orbit around Jupiter on 4 July 2016, it set all sorts of records: furthest operational solar-powered spacecraft, first spacecraft to enter polar orbit around another planet, first spacecraft with 3D-printed parts, and first spacecraft with a titanium vault to protect it from radiation. Did it also set a speed record? Yes and no.

To tear free from the gravitational clutches of the Earth, a spacecraft needs to hit a bare minimum velocity -- the escape velocity. This initial speed comes from a ferociously powerful launch. The New Horizons spacecraft holds the record for the fastest launch, but it did not pull many tricks to pick up speed on its way to Pluto and beyond into the Kuiper Belt. At over five times the mass of New Horizons, Juno was going far slower when it was relinquished by its launch rocket. However, the spacecraft added to that initial velocity by dipping back into Earth's gravitational well, stealing a bit of that potential energy for its journey and boosting its speed by 7,300 meters per second. Closing in on Jupiter, Juno surrendered to the gas giant's gravitational pull, falling in until it reached a peak velocity of 57,900 meters per second by the time it started braking to make orbit. This made Juno the fastest object to ever enter orbit around another planet, relative to Earth.

That last phrase is important. The entire universe is moving relative to something, so what are we using as the fixed point to measure the spacecraft's motion? John Bordi and Tom Pavlak, navigators for the Juno mission, explain in an email, "Velocity is always measured relative to something." On Earth, that's easy: measure relative to the starting point. However, as astrophysicist Jonathan McDowell explains, "Everyday concepts don't have a meaning when you change context." For things inside Earth's gravitational influence, it makes sense to use our home planet as reference by treating it as a fixed point in space. However, for anything that breaks free and travels beyond the Lagrange points -- points of gravitational equilibrium between the Earth and Sun -- it stops making sense to reference an object that is itself whirling around the Sun at 30,000 meters per second. Instead, spacecraft velocity is measured relative to the Sun. Bordi and Pavlak explain, "For interplanetary missions, this is kind of a natural way to look at things, since the planets and the spacecraft are all orbiting the Sun." When measured relative to the Sun, suddenly Juno does not look so impressive. At this particular moment in Earth's orbit, the geocentric and heliocentric velocities are nearly the same for the spacecraft. While fast, that is mere plodding compared to Helios 1 and 2, a pair of probes that orbited the Sun in the 1970s and 80s. While it was still functional, Helios 1 set a speed record of 66,000 meters per second measured relative to the Sun, or a scorching 96,200 meters per second relative to the Earth during just the right point of its orbit.

Juno will manage to get even faster during its second orbit around Jupiter, hitting an estimated 75,000 meters per second relative to Earth. However, even then, it will be beaten out for speed records by Helios 2 (92,720 meters per second), Messenger (91,090 meters per second), and probably even Mariner 10 (estimated 80,000 meters per second). Why do all these spacecraft in the inner solar system hold the speed records when deep space probes need to travel so much further? Anything in solar orbit is falling around the sun. "The closer you are to the Sun, the stronger its gravity is and the more it pulls you, so the faster you fall," McDowell explains, continuing, "So the orbital speeds get bigger deeper into the gravity well." By: Mika McKinnon

NASA captures the Moon crossing the face of the Earth, for the second time 13 July: The camera aboard NASA and NOAA's Deep Space Climate Observatory (DSCOVR) satellite captured images of the moon as it passed in front of the sunlit side of the Earth for the second time in a year.


An image EPIC took of the transit of the Moon in front of the Earth NASA

The Earth Polychromatic Imaging Camera (EPIC) onboard DSCOVR is a four-megapixel charge coupled device (CCD) camera and telescope that is orbiting at 1,609,344 km from Earth at L1 orbit. The mission of DSCOVR is to study the real-time solar wind for the National Oceanic and Atmospheric Administration (NOAA) as the satellite is strategically placed between the Earth and Sun. Meanwhile, EPIC is in constant view of the Earth by monitoring the ozone, cloud height, aerosols, and vegetation in the atmosphere.

The satellite is orbiting around the Sun-Earth system at the first Lagrange point, which is where the gravitational pull from the Sun is equal and opposite to that of the Earth. The orbit changes from elliptical to circular and back again in an orbit called a Lissajous orbit. DSCOVR, in its orbit, intersects the Moon's orbit approximately four times a year, but only appears between the Earth and the satellite only twice in a year. By: Jordan Rice

How Venus' cold cloud layers can reveal the world below 18 July: Venus is famously hot, due to an extreme greenhouse effect which heats its surface to temperatures as high as 450ºCelsius. The climate at the surface is oppressive; as well as being hot, the surface environment is dimly lit, due to a thick blanket of cloud which completely envelops the planet. Ground-level winds are slow, pushing their way across the planet at painstaking speeds of about 1 metre per second -- no faster than a gentle stroll.

However, that is not what we see when we observe our sister planet from above. Instead, we spy a smooth, bright covering of cloud. This cloud forms a 20-km-thick layer that sits between 50 and 70 km above the surface and is thus far colder than below, with typical temperatures of about -70 degrees Celsius -- similar to temperatures found at the cloud-tops of Earth. The upper cloud layer also hosts more extreme weather, with winds that blow hundreds of times faster than those on the surface (and faster than Venus itself rotates, a phenomenon dubbed 'super-rotation'). While these clouds have traditionally blocked our view of Venus' surface, meaning we can only peer beneath using radar or infrared light, they may actually hold the key to exploring some of Venus' secrets. Scientists suspected the weather patterns rippling across the cloud-tops to be influenced by the topography of the terrain below. They have found hints of this in the past, but did not have a complete picture of how this may work -- until now.

Scientists using observations from ESA's Venus Express satellite have now greatly improved our climate map of Venus by exploring three aspects of the planet's cloudy weather: how quickly winds on Venus circulate, how much water is locked up within the clouds, and how bright these clouds are across the spectrum (specifically in ultraviolet light). "Our results showed that all of these aspects -- the winds, the water content, and the cloud composition -- are somehow connected to the properties of Venus' surface itself," says Jean-Loup Bertaux of LATMOS (Laboratoire Atmosphères, Milieux, Observations Spatiales) near Versailles, France. "We used observations from Venus Express spanning a period of six years, from 2006 to 2012, which allowed us to study the planet's longer-term weather patterns."

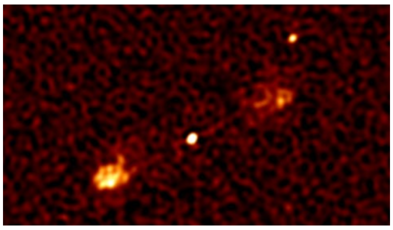
Although Venus is very dry by Earth standards, its atmosphere does contain some water in the form of vapour, particularly beneath its cloud layer. Bertaux and colleagues studied Venus' cloud-tops in the infrared part of the spectrum, allowing them to pick up on the absorption of sunlight by water vapour and detect how much was present in each location at cloud-top level (70 km altitude). They found one particular area of cloud, near Venus' equator, to be hoarding more water vapour than its surroundings. This 'damp' region was located just above a 4,500-metre-altitude mountain range named Aphrodite Terra. This phenomenon appears to be caused by water-rich air from the lower atmosphere being forced upwards above the Aphrodite Terra mountains, leading researchers to nickname this feature the 'fountain of Aphrodite.'

In parallel, the scientists used Venus Express to observe the clouds in ultraviolet light, and to track their speeds. They found the clouds downstream of the 'fountain' to reflect less ultraviolet light than elsewhere, and the winds above the mountainous Aphrodite Terra region to be some 18 percent slower than in surrounding regions. All three of these factors can be explained by one single mechanism caused by Venus' thick atmosphere, propose Bertaux and colleagues. "When winds push their way slowly across the mountainous slopes on the surface they generate something known as gravity waves," adds Bertaux. "Despite the name, these have nothing to do with gravitational waves, which are ripples in space-time -- instead, gravity waves are an atmospheric phenomenon we often see in mountainous parts of Earth's surface. Crudely speaking, they form when air ripples over bumpy surfaces. The waves then propagate vertically upwards, growing larger and larger in amplitude until they break just below the cloud-top, like sea waves on a shoreline." As the waves break, they push back against the fast-moving high-altitude winds and slow them down, meaning that winds above Venus' Aphrodite highlands are persistently slower than elsewhere. However, these winds re-accelerate to their usual speeds downstream of Aphrodite Terra -- this motion acts as an air pump. Wind circulation creates an upwards motion in Venus' atmosphere that carries water-rich air and ultraviolet -dark material up from below the cloud-tops, bringing it to the surface of the cloud layer and creating both the observed 'fountain' and an extended downwind plume of vapour.

This finding reveals that the amount of water and ultraviolet-dark material found in Venus' clouds is strongly enhanced at particular places around the planet's equator. "This is caused by the mountains way down on Venus' surface, which trigger rising waves and circulating winds that dredge up material from below," says Markiewicz. As well as helping us understand more about Venus, the finding that surface topography can significantly affect atmospheric circulation has consequences for our understanding of planetary super-rotation, and of climate in general. By: ESA, Noordwijk, Netherlands

The largest radio telescope in the southern hemisphere returns its first image

19 July: South Africa's MeerKAT telescope is still under construction, but ready to return valuable scientific information. MeerKAT is already the best radio telescope of its kind in the Southern Hemisphere. Array Release 1 (AR1) being celebrated today provides 16 of an eventual 64 dishes integrated into a working telescope array. It is the first significant scientific milestone achieved by MeerKAT, the radio telescope under construction in the Karoo that will eventually be integrated into the Square Kilometre Array (SKA).



MeerKat

In a small patch of sky covering less than 0.01 percent of the entire celestial sphere, the MeerKAT First Light image showed more than 1300 galaxies in the distant Universe, compared to 70 known in this location prior to MeerKAT. "Based on the results being shown today, we are confident that after all 64 dishes are in place, MeerKAT will be the world's leading telescope of its kind until the advent of SKA," according to Professor Justin Jonas, SKA South Africa Chief Technologist.

MeerKAT will consist of 64 receptors, each comprising a 13.5-metre diametre dish antenna, cryogenic coolers, receivers, digitiser, and other electronics. The commissioning of MeerKAT is done in phases to allow for verification of the system, early resolution of any technical issues, and initial science exploitation. Early science can be done with parts of the array as they are commissioned, even as construction continues. AR1 consists of 16 receptors, AR2 of 32 and AR3 of 64, expected to be in place by late 2017.

Dr Rob Adam, Project Director of SKA South Africa, says: "The launch of MeerKAT AR1 and its first results is a significant milestone for South Africa. Through MeerKAT, South Africa is playing a key role in the design and development of technology for the SKA. The

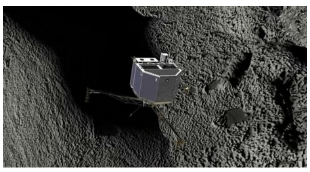
South African team of more than 200 young scientists, engineers and technicians, in collaboration with industry, local and foreign universities and institutions, has developed the technologies and systems for MeerKAT. These include cutting edge telescope antennas and receivers, signal processing, timing, telescope management, computing and data storage systems, and algorithms for data processing." By: MeerKAT

Another dark matter search comes up empty 22 July: The world's most sensitive dark matter detector, the Large Underground Xenon (LUX) detector, which is stationed beneath a mile of rock at the Sanford Underground Research Facility, just completed its 20 month search for the 'missing mass' of the universe, coming up empty.

The LUX team is confident that if a particle did interact with the xenon, they would have detected it as the sensitivity of the detector is very precise. With these new findings (or lack thereof), scientists will be able to eliminate many potential inaccurate dark matter models and offer guidance to the next generation of dark matter detectors. "LUX has delivered the world's best search sensitivity since its first run in 2013," said professor Rick Gaitskell from Brown University. "With this final result from the 2014-2016 run, the scientists of the LUX Collaboration have pushed the sensitivity of the instrument to a final performance level that is 4 times better than originally expected. It would have been marvellous if the improved sensitivity had also delivered a clear dark matter signal. However, what we have observed is consistent with background alone."

Even though dark matter has not yet been found, scientists are confident it exists as its effects can be seen in the rotation of galaxies and the bending of light as it makes its way through the universe; it is believed to account for more than four-fifths of the total mass in the universe. The LUX experiment was designed to look at the leading theory type of dark matter particle called a WIMP, Weakly Interacting Massive Particles. It is believed that billions of these particles pass through us, the Earth, and everything on it; WIMPs don't interact very strongly with normal matter therefore these ghost-like particles pass through with no evidence they were ever there. The LUX detector consists of a third-of-a-ton of cooled liquid xenon that is surrounded by very powerful sensors designed to detect tiny flashes of light and electrical charges that may be emitted if a WIMP collides with a xenon atom. As cosmic rays and other radiation could interfere with the dark matter signals, the detector was placed beneath a mile of rock and inside a 72,000-gallon water tank. By: Jordan Rice

Philae prepares to take its eternal rest 26 July: Tomorrow at 5 am ET, ESA will say a final good-bye to its ill-fated comet lander, Philae. At that time, ESA will shut down the Electrical Support System Processor Unit — the only communication relay between Philae and the Rosetta orbiter, which then sends the message back to Earth.



ESA

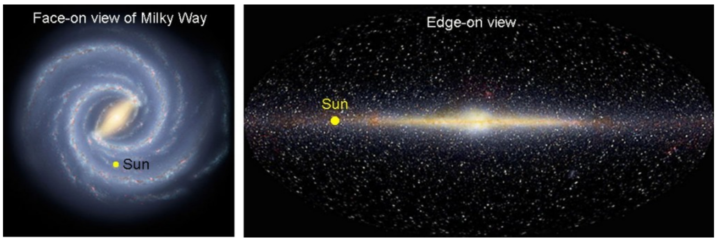
It has been more than a year since ESA has heard from Philae. The probe missed its intentional landing spot in November 2014 and instead landed in a poorly lit area of the comet, dooming the solar powered probe to frequent moments of powerlessness. Now, with Rosetta itself winding down its mission and aiming for a controlled descent onto Comet 67P as the comet heads out past Jupiter, out of reach of the Sun. The probe needs all the power it can get in the meantime — including that coming from the communications relay with the sleeping lander.

So tomorrow, barring a miraculous recovery, Philae will lose its last link with the world. In its short time, it still returned data on the surface composition of the comet, as well as the sort of 'atmosphere' around it from the sublimation of ices on the surface. It also detected a series of organic compounds on the comet. Not bad for a comet that went dark not long after it landed and only intermittently came back to life afterwards for a few days in July 2015. By: John Wenz

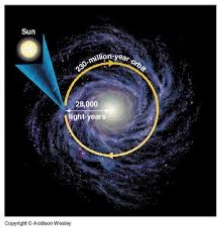
Source of these and further astronomy news items: www.astronomy.com/news

DID YOU KNOW?

The Sun Part 5 **Sun – position and orbit**



Sun's position in the Milky Way



Sun's orbit

Milky Way galaxy The Milky Way galaxy is huge, around 100,000 light years (ly) across. It is known to be a spiral galaxy, with a central disk surrounded by a series of spiral arms. However, observations of its structure and measurements of the spiral arms are hampered by obscuring dust in the disk and the difficulty of estimating massive distances from within the structure.

The Sun is just one of around 200 billion stars within the galaxy. While the oldest parts of the Milky Way are estimated to be from 12-14 billions years old, the Sun, aged around 4.6 billion years, is one of the many younger stars in he galaxy.

Stars are classified into three populations on the basis of certain physical characteristics. Population lll stars were the oldest, and Population l stars are the youngest. The Sun is a Population l star, located in the thin disk which surrounds the central core of the Milky Way, it follows a roughly circular orbit, and it has a high content of heavy elements (those heavier than hydrogen and helium). The latter feature is a result of the availability of these elements released by dying older Population ll stars.

Position in the Milky Way galaxy Within the galactic disk, the Sun currently lies close to inner rim of the Orion arm in the Local Interstellar Cloud (Gould Belt), 25,000-28,000 light years (ly) from the galactic centre. The Orion arm is positioned between the inner Sagittarius arm and the outer Peruses arm. The distance from the Orion arm to the Peruses arm, is about 6,500 ly. The Sun is contained within the Local Bubble, a space of rarefied hot gas, possibly produced by a supernova remnant.

The Sun and its planets are found in the galactic habitable zone, the region of a galaxy in which life is most likely to develop. It is hypothesised that such regions incorporate various factors, including the rate of major events like supernovas and the presence of elements heavier than hydrogen and helium ie metals which increase the likelihood of formation of the rocky planets suitable as locations for the development of life. The rate of major catastrophic events, like supernovae, and star numbers which can initiate avalanches of comet and asteroid impacts and liberate damaging levels of radiation are also important. This rate needs to be enough to liberate necessary amounts of heavier elements, but not so much that they pose a threat to any evolving life. In this respect, the Sun is in an advantageous position, being located on the edge of a spiral arm where stellar densities are relatively low.

Solar orbit One solar orbit through the Milky Way, a galactic (or cosmic) year, takes about 225-250 million years to complete. So far, the Sun would have completed 20-25 orbits. Its orbit around the galaxy is predicted to be roughly elliptical, with addition of perturbations due to the spiral arms and non-uniform mass distributions. It also oscillates up and down relative to the galactic plane approximately 2.7 times per orbit.

The orbital speed of the solar system is around 250 km/sec. It, thus, takes the Sun and planets around 1,190 years to travel 1 ly, or only days to travel 1 AU. The direction towards which the Sun travels through space within the Milky Way relative to other stars is called the solar apex. As a result of this motion, stars seem to be converging towards a point in the opposite direction, the solar antapex. The direction of the solar apex cannot be defined precisely because of the random motions of the stars themselves. The general direction of the Sun's galactic motion is towards Vega (Lyra) at an angle of around 60 sky degrees to the galactic centre.

Some have noted that mass extinctions on Earth have often coincided with the Sun's passage through the higher density spiral arms, possibly due to associated impact events.

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)	028 313 0109
Laura Norris (Treasurer)	028 316 4453
Peter Harvey (Secretary, monthly sky maps)	028 316 3486
Jenny Morris (Vice-chairperson, newsletter)	071 350 5560
Karin de Bruin (Observing)	028 316 2080
Derek Duckitt (Website editor)	082 414 4024
Bennie Kotze (Outreach co-ordinator)	128 316 3666
Deon Krige (Youth robotics project, astro-photography)	028 314 1045
John Saunders (Guest speakers and events)	tibouchina286@gmail.com

Non-committee members with roles:

Pierre Hugo (Cosmology interest group)	028 312 1639
Johan Retief (Hawston School Youth Club)	028 315 1132