`"The Southern Cross"

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HERMANUS ASTRONOMY CENTRE NEWSLETTER

AUGUST 2020

Monthly meeting These resume this month via Zoom. This months meeting will take place on the evening of **Monday 17 August.** Access and start time details will be circulated to members closer to the time. Centre member, Jenny Morris, will be talking on `**1820 and all that: Establishment of the Cape Observatory, and scientific connections with the Cape'.** See below for details.

Cosmology The activities of this interest group will restart on the evening of **Monday 3 August** The next two parts of the current DVD series "Black holes, tides and curved spacetime: Understanding gravity' presented by Prof Benjamin Schumacher of Kenyon College will be shown via Zoom. Access and start time details will be circulated to members. See below for details on the content.

2020 meeting dates For your diaries. Remaining meeting dates are: 21 September, 19 October and 16 November.

WHAT'S UP?

Antares The noticeable red supergiant star which marks the 'heart' of the scorpion in the eponymous constellation Scorpio is the sixteenth brightest star in the night sky. The diameter of Alpha (α) Scorpii is 400 times wider then The Sun, and 10,000 times brighter than our star. It is 554 light years away from Earth. It is a variable star whose brightness varies from magnitude (brightness) 0.9 – 1.2 over a 4-5 year period. It has a small dwarf companion with an orbital period of around 1,200 years. The Greek name Antares translates as 'like Mars' or 'rival of Mars' in recognition of the notable red of its colour. Like other red supergiants eg Betelgeuse (Orion) Antares is approaching the end of its life, having finished burning its hydrogen. Its red colour and great size are the result of processes occurring while it is burning its helium. It will probably die in the massive explosion of a supernova and become either a neutron star or a black hole.

LAST MONTH'S ACTIVITIES

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

Interest groups

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

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

Other activities

Educational outreach

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

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's meeting, will take place on the evening of **Monday 17 August** via Zoom. Access and start time details will be circulated to members. In recognition of the bicentenary of the SAAO, Centre member, Jenny Morris, will be talking on '**1820 and all that: Establishment of the Cape Observatory, and scientific connections with the Cape'**.

Jenny states: '1820 and the Cape. Central to the establishment of the South African Astronomical Observatory, this date and location also have wider significance in scientific history. In addition to astronomy, they played important roles in fundamental advances in other branches of science including geology, botany, zoology, surveying, geography, evolution, navigation and medicine. Events which took place in 1820 are linked with the lives of several luminaries including Charles Darwin, Capt James Cook, Sir John Herschel, George Everest, Joseph Banks, Anders Sparman and Sir Thomas Maclear, all of whom visited the Cape at various times. Exploring the lives of these men opens a fascinating window on the era of exploration and rapid scientific discovery, and shows the intriguing alignment between events of one year of that era and a distant outpost at the southern tip of Africa.'

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting, on the evening of **Monday 3 August** will be shown via Zoom. Access and start time details will be circulated to members. The next two lectures in the DVD series 'Black holes, tides and curved spacetime: Understanding gravity' presented by Prof Benjamin Schumacher of Kenyon College will be shown. The topics are: L9: 'Nudge - Perturbation of Orbits' and L10: 'Resonance - Surprises in the Intricate Dance'.

For further information on these meetings, or any of the group's activities, please contact Derek Duckitt at derek.duckitt@gmail.com

Astro-photography This group meets on the second Monday of each month. Members are currently communicating digitally about image processing which they can do at home.

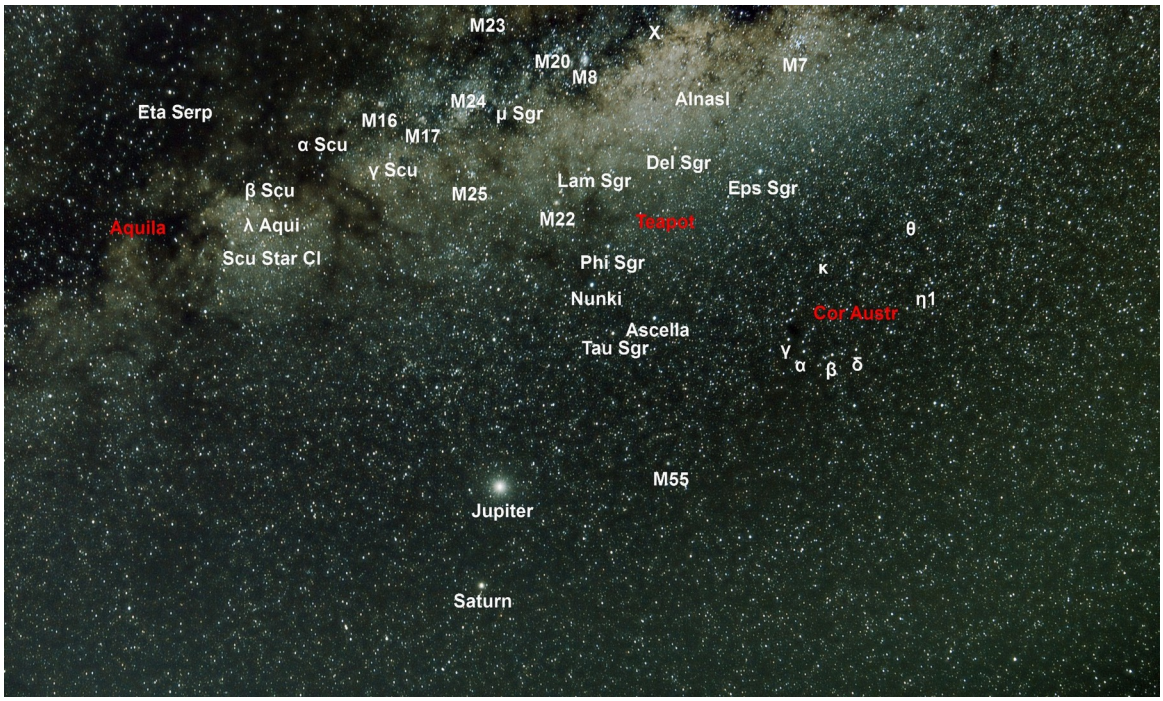
To find out more about the group's activities and the venue for particular meetings, please contact Deon Krige at astronomy.hermanus@gmail.com

Hermanus Youth Robotic Telescope Interest Group There is no update.

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

Other activities

Stargazing No events will take place during the coronavirus pandemic. The following impressive image and details were submitted by Pierre de Villiers. Pierre states: "The photo was taken on 5 March 2019 at OppieKoppie, a guest house on a farm about 10 km South-West of Bonnievale towards McGregor. Derek, Bennie, Peter and I were there (the usual Southern Star Party crowd)."



"The attached image was obtained by taking 30 x 20 second exposures with a Canon 500D (old!) DSLR camera mounted on a tripod together with 17 x 20 second darks (lens cap on) at the same temperature/time, calibrating the images by subtracting the thermal noise and bias from the lights, stacking and processing further in Pixinsight.

Google the objects annotated if you wish to find out more than the descriptions below. Starting from the bottom Saturn and Jupiter were quite prominently visible on 4th July 2020. No Galilean moons of Jupiter or Saturn's rings are visible because of the wide field of the image and both planets' brightness.

Messier 55 (M55), or NGC 6809, is one of the nearest globular clusters to the Solar System. It has a loose grainy appearance even in 7 x 50 binoculars.

The Teapot is one of the most prominent asterisms in the Southern Skies formed by the brightest stars in Sagittarius, the Archer. Ironically, the multiplicity of stars "mask" normally pronounced asterisms, like the Teapot. The Teapot is formed by the ***Handle*** (Phi Sgr, Nunki [Sigma Sgr], Tau Sgr & Ascella [Zeta Sgr]), ***Pot*** (Phi Sgr, Ascella, Eps Sgr & Del Sgr), ***Lid*** (Lambda, Phi & Delta Sgr) and ***Spout*** (Epsilon Sgr, Delta Sgr and Alnasli [Gamma2 Sgr]). The "steam" is the very dense concentration of stars in the centre of the Milky Way near its centre, marked by the X.

Below (South) of the Teapot is the constellation *Corona Australis,* or Southern Crown, whose most prominent stars are Kappa, Gamma, Alpha, Beta, Delta, Eta1 and Theta CrA). M7 or Ptolemy's Cluster is a huge open cluster visible to the naked eye as a concentrated patch in the Milky Way. Telescopic observations reveal about 80 stars in a field of view of 1.3º.

M8 or the Lagoon Nebula, is a bright emission nebula and an H II region of interstellar atomic hydrogen that is partially ionised by recent star formation. It is faintly visible to the naked eye and together with the Orion nebula (M42) the only two star-forming regions visible to unaided eyes.

2º North of M8 is M20 (NGC6514), the Trifid nebula. Named for its three-lobed appearance, the Trifid has the unusual combination of an open cluster, a reddish emission and blueish reflection nebulosity and a dark nebula that divides the emission nebula into three parts.

Mu (μ) Sagittarii or Polis is a 3rd magnitude bright star about a binocular field (5º) NW of λ Sgr and is a useful reference star for objects in its vicinity.3º NNW of M20 is the open cluster M23 (NGC6494), which is glorious site for binoculars & small telescopes. It is located in the rich star-fields of the Sagittarius Milky Way and contains about 150 stars in an area 27 arcminutes across.

Moving North from the Teapot's handle is M22 (NGC6656), one of the finest globular clusters in the sky – third after Omega Centauri and 47 Tuc - and one of the first to be discovered in 1665. It is visible with the naked eye on a clear and contains about 500,00 stars.

A binocular field (5º) North of M22 is M25 (IC 4725), a fine open cluster for binoculars and small telescopes, which contains three dozen stars scattered over a 32 arc-minute area. About 3º West of M25 is M24, the Sagittarius Star Cloud, which is a pseudo-cluster of stars visible through a tunnel in the Milky Way's interstellar dust. It is the densest concentration of stars visible through binoculars with around 1,000 stars visible in a single field of view.

2º NNE of M24 is M17 (NGC6618), the Omega, Swan, Horseshoe or Lobster Nebula, which is a bright H II emission nebula region. It is just visible to the naked eye under dark skies. In a small telescope it rivals the Orion Nebula (M42) in splendour.

Another 3º NNE of M17 is M16 (NGC661), the Eagle Nebula in the constellation Serpens Cauda. It is a giant cloud of interstellar gas and dust and has already created a cluster of young stars. With a visual magnitude of 6.4 it is best viewed through low power telescopes. The famous "Pillars of Creation" image of the star-forming region taken by the Hubble Space Telescope in 1995 is not only one of Hubble's best-known images, but also greatly improved our understanding of the star formation process in nebulae.

The 4 brightest stars in Scutum (The Shield), named by Johannes Hevelius in 1684 are α, β, δ and γ Scuti. They do actually form the shape of a medieval shield, which honours the Polish king John Sobieski for his defence of Vienna in 1683. The Scutum Star Cloud is a very bright section of the Milky Way and in the constellation Serpens Cauda – hence the name.

M26, the Wild Duck open cluster, is not discernible in this image. Eta Serpentis Cauda is a naked eye star in the tail of the Sea Serpent (or Monster). Its head is to the West of the

constellation Ophiuchus, the Serpent Bearer. λ Aquilae is the only star of the constellation Aquila, the Eagle clearly identifiable. Altair or α Aquilae is the brightest star in the constellation. It is just off the image. Enjoy.'

FUTURE TRIPS

No outings are being planned, at present.

2020 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month. For the present, they will be presented via Zoom. Remaining dates for this year are: 21 Sept, 19 Oct, 16 Nov. Topic and speaker details will be circulated to members closer to the time.

ASTRONOMY SELF-GUIDED EDUCATION CENTRE (ASEC)

Work continues on planning and administrative requirements for work to begin on the proposed Astronomy Self-guided Education Centre, to be located within the existing whale-watching area at Gearing's Point.

The **Friends of the Observatory campaign** was launched several years ago when preliminary work began on plans to construct an astronomical observatory in Hermanus. Over the years, members have been very generous, for which we are deeply grateful. It may seem logical to assume that, now money has been awarded by the National Lotteries Board, pledge monies are no longer needed. Unfortunately, that is not the case. NLC funds can only be used once the plans have been formally approved by the Municipality.

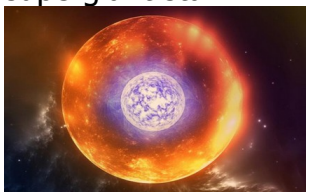
We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer,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

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

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

ASTRONOMY NEWS\

Thorne-Żytkow objects: When a supergiant star swallows a dead star 2 July: Nearly half a century ago, physicist Kip Thorne (now a Nobel laureate) and astronomer Anna Żytkow suggested a strange, Russian-nesting-doll-type star might be hiding in the cosmos, just waiting to be found by those who knew how to seek it. Astronomers named these theoretical stellar hybrids Thorne-Żytkow objects. The possible existence of Thorne-Żytkow objects came to light when their namesake researchers ran early computer simulations. When they did, they found that a neutron star - a tiny, ultra-dense stellar remnant left behind when a star goes supernova - could be gobbled up by a red supergiant star.



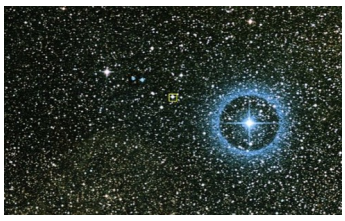
A Thorne-Żytkow object is a theoretical type of hybrid star created when a dense neutron star is swallowed by a puffy red supergiant star, as seen in this artist's concept. *Astronomy* magazine

According to the simulations, if the "Twins" (in the Danny DeVito-Arnold Schwarzenegger sense) get too close to one another, instead of one star getting ejected, the two stars can merge together. The city-sized, solar-mass neutron star would carry on living inside its much larger host, almost like a cosmic parasite. However, even if physics really allows for such stars to exist, finding them will be hard.

In a study published in 1975, Thorne and Żytkow suggested these stars would look almost identical to red supergiants like Netyelgeuse, in the constellation Orion. Supergiant stars are relatively common and are some of the youngest and largest stars in the universe. Thorne-Żytkow objects (TZOs) would look very similar to red supergiants, but are suspected to survive up to 10 times longer. Ordinary red supergiants, like other stars, are powered by nuclear fusion in their cores. So when that energy runs out, their uncontested gravity causes them to implode before erupting as a supernova. In contrast, TZOs can live such long lives because they do not rely on sustained nuclear fusion in their cores to avoid collapse. Instead, a TZO's neutron star core, which is already extremely compressed, largely prevents the rapid and uncontested gravitational collapse of the surrounding supergiant layers.

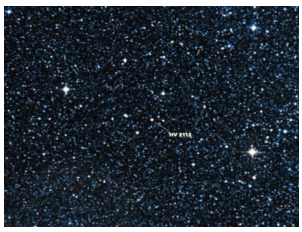
Astronomers have two different theories for how TZOs form - and they both depend on the initial objects starting their lives as two gigantic stars in a close binary system. In one theory, the bigger of the two stars would explode as a supernova first, leaving behind a neutron star. Over time, the remaining supergiant would continue to balloon outward, growing until it fully swallowed the nearby neutron star remnant. Another possibility for the formation of TZOs is that when one star explodes as an asymmetric supernova, its remnant core could get a powerful 'kick'. That could potentially fire the neutron star into the belly of the remaining red giant.

No matter how they form, astronomers in 2014 announced they might have discovered the first Thorne-Żytkow object. The star was hiding some 200,000 light-years away in the Small Magellanic Cloud, a dwarf galaxy that orbits the Milky Way. It was found by astronomer Emily Levesque, now at the University of Washington, with the help of her team of researchers. To find the suspected TZO, Levesque's group used New Mexico's Apache Point Observatory to study two dozen red supergiant stars in the Milky Way, as well as one of the Magellan Telescopes in Chile to study another group of supergiants in the Small Magellanic Cloud. Upon reviewing the data, one star in particular stood out. The system, dubbed HV 2112, was initially cataloged as variable in 1908 by pioneering astronomer Nenrietta Swam Leavitt. At the time, though, astronomers thought it was a red supergiant living out its dying days before going supernova.


A candidate Thorne-Żytkow object (yellow box) shines among the stars of the Small Magellanic Cloud. ESA/Hubble

However, more than 100 years after Leavitt first noted the strange object, Levesque and her team's analysis revealed unusual chemical signatures that they thought could be the tell-tale signs of a mythical Thorne-Żytkow object. The researchers saw excess amounts of

lithium, calcium, and other elements, which they could only explain through the unique nuclear reactions that would occur inside a TZO. However, they could not be completely sure; HV 2112 also seemed to have other strange chemical fingerprints that they did not expect to see. Based on these remaining mysteries, the team suggests that either theoretical models haven't fully appreciated the nuances of Thorne-Żytkow objects, or HV 2112 simply was not a TZO in the first place.


The giant variable star HV 2112, shown here, was considered a promising candidate as the first Thorne-Żytkow object. Digital Sky Survey/Center de Données astronomiques de Strasbourg

The bizarre nature of the find sparked headlines at the time. For astronomers, it was also an important discovery because it offered evidence for stars powered by processes beyond nuclear fusion. Four years later, in 2018, another group of astronomers pushed 'pause' on this unique find. They had done their own analysis of HV 2112 and compared it to similar stars, but did not find the same levels of excess calcium or other elements spotted by Levesque's team. The new analysis did show a surplus of lithium, but, other than that, the results suggested this star was basically an ordinary red supergiant. Though the team might have dashed HV 2112's dreams of being different, they did offer up the hope a replacement candidate. They found another possible Thorne-Żytkow object, catalogued as HV 11417, which did sport some of tell-tale signs that astronomers predicted the objects should have. One thing the two teams do agree on is that when it comes to Thorne-Żytkow objects, both theory and observation still have a long way to go. By: Eric Betz

A fresh look at a cosmic 'jewel bug' 9 July: On Earth, jewel bugs, which sport brilliant metallic shells, can be found all across the globe. However, NGC 7027 is the only place in the universe where you can find a stellar version of the terrestrial insect.


Planetary nebula NGC 7027, seen here, is a beautiful, expanding cloud of gas and dust sent out during a star's final death throes. NASA/ESA/J. Kastner (RIT)

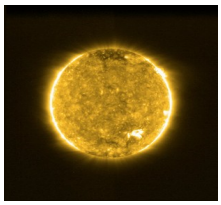
Located about 3,000 light-years away in the constellation Cygnus, NGC 7027 is a glowing bubble of expanding gas - known as a planetary nebula - that happens to have a shape roughly reminiscent of a shielded jewel bug. The Hubble Space Telescope captured this pastel-coloured image of NGC 7027 in near-ultraviolet (NUV) light, which borders visible light on the spectrum. This was the first time NGC 7027 was observed in this wavelength. Astronomers have frequently studied NGC 7027 before, but with the new NUV observations, researchers hope to learn more about the amount of dust that obscures the jewel bug's central star, as well as how hot that star really is.

Planetary nebula NGC 7027 was formed when a dying star cast out its outer layers due to increasing stellar winds, creating a distinct bubble-like feature. Despite their name,

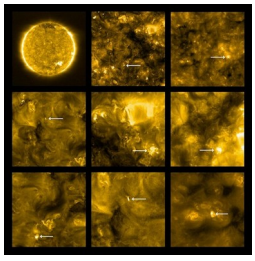
however, planetary nebulae have nothing to do with planets. They are so-called because William Herschel, who studied the cosmic wonders over 200 years ago, noticed they looked round like the planets. Astronomers will be able to study how NGC 7027 has changed over time by comparing past research with the new observations, giving them a better understanding to how stunning planetary nebulae evolve over time.

By: Hailey Rose McLaughlin

Solar Orbiter sends back the closest photos of the Sun ever taken 16 July: The joint NASA/ESA Solar Orbiter satellite, which plans to spend the next seven to 10 years studying the Sun, just sent back the closest images of our home star ever taken. Among them are detailed views of the Sun's magnetic field, as well as snapshots of tiny bright spots that scientists are calling 'campfires'.

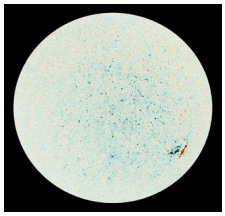

Solar Orbiter's first full view of the Sun, taken at ultraviolet wavelengths on May 30. Solar Orbiter/EUI Team/ ESA & NASA; CSL, IAS, MPS, PMOD/WRC, ROB, UCL/MSSL

Launched 9 February 9 from Cape Canaveral Air Force Station in Florida, Solar Orbiter will explore the forces that power the steam of particles constantly flowing from our Sun, called the solar wind. It will take about two years for the satellite to reach its final orbit. Once in place, its unique path will allow it to capture the very first high-resolution images of the Sun's poles. It completed its first close pass of the Sun last month, coming within just 77 million kilometres of our star. During this pass, the spacecraft's suite of 10 instruments went to work observing our star and its surroundings. Researchers wanted this data to simply confirm the instruments are working properly - which they are. However, scientists did not expect to make new discoveries.


Solar Orbiter's Extreme Ultraviolet Imager spotted tiny bright spots on the Sun, indicated by white arrows in this mosaic. The mini-flares are now dubbed campfires. Solar Orbiter/ EUI Team (ESA & NASA); CSL, IAS, MPS, PMOD/WRC, ROB, UCL/MSSL

Of Solar Orbiter's six imagers, its Extreme Ultraviolet Imager (EUI) sent back the most intriguing photos, capturing a vast army of small bright spots, each about a millionth to a billionth the size of a traditional solar flare. These so-called campfires are "the little nephews of solar flares," said EUI Principal Investigator David Berghmans, of the Royal Observatory of Belgium. They are, according to Berghmans, "literally everywhere we look." It is possible these campfires are simply miniature versions of the flares we spot from Earth. However, they also may be related to nanoflares, which are small, brief, ubiquitous bursts of energy that occur across the Sun and are increasingly thought to be responsible for our star's surprisingly hot outer atmosphere, or corona. Just how the corona gets so hot - some 300 times hotter than the Sun's surface - is not well

understood. So, helping to solve this mystery is one of Solar Orbiter's many mission goals. The next step, according to the Solar Orbiter team, is to eventually measure the campfires' temperatures with the craft's Spectral Imaging of the Coronal Environment instrument.


The Polarimetric and Helioseismic Imager aboard Solar Orbiter mapped the magnetic properties of the Sun on June 18, including a large active region visible at lower right. Solar Orbiter/PHI Team/ESA & NASA

Another instrument, the Solar and Heliospheric Imager (SoloHI), sent back shots of the zodiacal light, which occurs when sunlight reflects off dust particles in our solar system. Although these images do not signify a new discovery, taking them required SoloHI to tamp down the Sun's glare to just a trillionth its actual brightness. By successfully completing the task, researchers are confident SoloHI can produce the image quality needed to study the solar wind (the instrument's intended purpose) once the mission ramps up. The Polarimetric and Helioseismic Imager (PHI) also beamed back high-resolution data showing the Sun's intricate and powerful magnetic field. In a first, PHI revealed a view of a local magnetic field on the Sun that was not visible from Earth at the time, exemplifying just one advantage of the spacecraft's intentionally tilted orbit.

The Sun's magnetic field drives numerous internal processes, which can produce solar flares and other powerful outbursts. Such energetic solar events can affect us here on Earth, too - from sparking stunning auroras to knocking out satellite communications and earthbound power grids. By monitoring the Sun with spacecraft such as Solar Orbiter and the Parker Solar Probe, scientists should be able to better predict when Earth-affecting space weather will occur. All in all, these first results show that we still have much to learn about our home star, as well as the forces that power its frequently finicky behaviour.

By: Alison Klesman

The United Arab Emirates successfully launches its first Mars mission 20 July: After two weather-related delays, the United Arab Emirates (UAE) has successfully launched its first interplanetary probe, putting a nearly 1,350 kilogram spacecraft into Earth orbit in preparation for its seven-month journey to Mars. Once the Emirates Mars Mission (EMM) reaches the Red Planet in February 2021, it will begin a two-year science mission that will help researchers piece together the first full picture of how Mars' climate changes over the course of an entire Martian year. The spacecraft, dubbed al-Amal (Hope), launched from Japan's Tanegashima Space Centre on 20 July (local time). The historic launch kicked off the first interplanetary mission from an Arab nation, and Hope's arrival at the Red Planet is set to coincide with 50th anniversary of the Emirates' independence.

Hope will build on the legacy of NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) orbiter, which is still functioning in orbit around Mars. Among other things, MAVEN revealed just how quickly the solar wind stripped Mars of its primoridal atmosphere. One goal of Hope is to answer lingering questions about how the Sun continues to affect Mars'

atmosphere on a global scale today. To that end, Hope carries three instruments: a digital imager that will measure water ice and ozone in Mars' lower atmosphere; an infrared spectrometer that will measure the global distribution of dust, ice clouds, and water vapour in Mars' lower atmosphere; and a spectrometer that will measure the variability of hydrogen and oxygen in Mars' upper atmosphere. Over the course of about 10 days, Hope will collect atmospheric data covering the entire planet at varying local times of day, says Pete Withnell of the University of Colorado at Boulder. This will, for the first time, enable scientists to track and understand the daily cycle of Mars' temperature, water vapour, and dust, he says.


The Hope Mars orbiter as it appears with its solar panels fully deployed; its suite of instruments is visible on the underside of the main spacecraft body. MBRSC/CU-LASP

Previous missions to Mars have provided data at either fixed local times (from orbiters) or at mostly fixed locations on the surface (from rovers), says Withnell. While these missions have provided a wealth of knowledge, questions about the overall climate of Mars and the behaviour of its atmosphere remain unanswered, he says. Through EMM, Withnel adds, scientists will finally be able to pull together a global understanding of the Red Planet. By simultaneously observing both Mars' lower and upper atmosphere, and by observing them together at all times of day, researchers will get a better understanding of the coupling between the two layers of the planet's atmosphere, explains Bruce Jakosky, a planetary scientist at the University of Colorado at Boulder and an EMM science team member. Because this coupling passes gases from the lower atmosphere to the upper atmosphere that are subsequently lost to space, he says, the team expects the results to have an impact on our understanding of Mars' long-term atmospheric evolution. By better understanding Mars' changing atmosphere, researchers hope to gain insight into how ancient Mars turned from what may have been an ocean-rich Eden into the barren desert world with an extremely thin atmosphere that it is today.

Surprisingly, the mission's biggest technical challenge - so far - had little to do with design and engineering of the spacecraft itself. The most challenging hurdle was simply getting the spacecraft to the Japanese launch site in the middle of a global pandemic, says Omran Sharaf, EMM's project director. The researchers did not expect the routine transfer of Hope from Dubai to Tanegashima to become such a mission-critical race against time, but the COVID-19 pandemic forced airport closures, says Sharaf, which greatly complicated its journey to the launch pad.

As for the mission's impact on science, technology, engineering and maths (STEM) and aerospace studies in the UAE, Sharaf says EMM has already inspired Emiratis who want to pursue aerospace engineering and planetary science. The UAE is now offering space systems engineering degrees in universities - which was not the case when EMM was first announced in 2014, says Sharaf. The country is also seeing a tremendous boost in universities offering a wide variety of STEM degrees, as well as an uptick in students switching majors from other subjects to science, adds Sharaf. All this is in addition to the UAE's existing Arab Space Pioneer program, which invites talented young people from

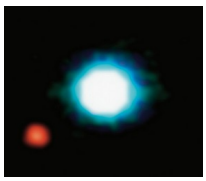
around the Arab world to the Emirates to learn about satellite engineering and space sciences. By: Bruce Dorminey

Two exoplanets seen dancing around Sun-like star for the first time 22 July: In another exoplanetary first, the European Southern Observatory's Very Large Telescope (VLT) in Chile's Atacama Desert has captured an image of two worlds orbiting a younger version of the Sun. The system, called TYC 8998-760-1, is located roughly 300 light-years away in the southern constellation Musca. Although it hides two gas giants orbiting a Sun-like star, we do not have anything quite like these worlds in our own solar system.


The first direct image of two exoplanets orbiting a Sun-like star, seen here, was captured by the SPHERE instrument on the ESO's Very Large Telescope. The system is called TYC 8998-760-1 and is located some 300 light-years from Earth. ESO/Bohn et al.

The inner planet lies about 160 astronomical units from its host star (where one astronomical unit, or AU, is the average Earth-Sun distance) and is some 14 times the mass of Jupiter. With that amount of heft, the gas giant skirts the border between planet and brown dwarf, which is a type of almost-star. The more distant planet is located about 320 AU from its star and weighs in at about six Jupiter masses. The system's star, meanwhile, has about the same mass as our own Sun (give or take a few percent due to uncertainties). However, it's only 17 million years old - which makes our roughly 4.5-billion-year-old Sun about 265 times older. "This discovery is a snapshot of an environment that is very similar to our solar system, but at a much earlier stage of its evolution," lead author Alexander Bohn, a PhD student at Leiden University in the Netherlands, said.

While astronomers know of thousands of exoplanets, they' have found the vast majority of them by tracking the indirect effects that the worlds exert on their host stars, like causing them to wobble or temporarily blocking their light. Capturing a direct image of an exoplanet is much more challenging, as the glare of the star tends to overpower the faint light reflecting off the planet. Since the first direct image of an exoplanet was captured in 2014, also by the VLT), fewer than 50 exoplanets have been directly imaged, according to NASA's Exoplanet Archive. Only two other systems with multiple planets have been definitively seen, though neither of those have Sun-like host stars.


The first direct image of an exoplanet (the red object at lower left in this composite image) was captured by the Very Large Telescope in 2004. The blue-white object at center is the brown dwarf, 2M1207b, that the planet orbits. ESO

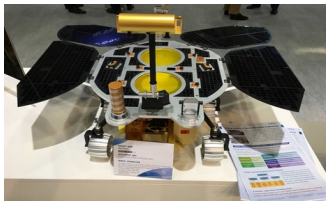
To image TYC 8998-760-1, the international team of researchers used an instrument called the Spectro-Polarimetric High-contrast Exoplanet Research (SPHERE), which is specifically designed for the VLT so it can better hunt for exoplanets. Although it is a ground-based instrument, it uses state-of-the-art adaptive optics to correct for image distortion caused by Earth's turbulent atmosphere, and a coronagraph to help block excess

light from the target star. Bohn and his colleagues first spotted the larger, innermost planet in this system in 2017. However, it was not until 2019 that they confirmed it with more data. Further follow-up observations revealed another surprise, though - an object that looked like another planet, but was smaller, cooler, and much farther from its host star.

To confirm their newly spotted, second pinprick of light was actually a planet and not a background star, the team conducted more observations in February 2020. In the year since their last observations, the positions of the background stars had shifted ever so slightly. However, when the researchers looked again, the two planets and their host star had remained in lockstep with each other, indicating they are part of the same system. Such a confirmation is a tribute to SPHERE's extreme astrometric precision - or ability to measure the precise locations and motions of celestial objects. "I do not think that any other instrument that is currently available in the Southern Hemisphere would have enabled this detection with a baseline of only one year," Bohn says.

Most intriguing to Bohn, however, is how wildly far these planets are from their host star. "They're "so much farther out than any known solar system planet," he added, despite the fact that their star is so similar to our Sun. (For comparison, our most distant known planet, Neptune, is an average of 30 AU from the Sun. The inner planet of TYC 8998-760-1 sits more than 10 times farther out.) Moving forward, Bohn wants to know if these planets started their lives that far from their host star, or rather formed closer in before later moving out. Nonetheless, the image, he says, is photographic proof" that planetary systems can look very different from our own solar system." By: Mark Zastrow

Tianwen-1: China successfully launches its first Mars rover 23 July: As most of North America went to bed last night, China was busy making history. On 23 July, the China National Space Administration (CNSA) launched its Tianwen-1 spacecraft, which carries the country's very first Mars rover and orbiter. If China succeeds, it will be their first successful mission to Mars, and make them just the third nation in history to land on the Red Planet, after the United States and the Soviet Union. Tianwen-1 should reach Mars in February 2021, where the spacecraft will separate and deploy a Mars-orbiting satellite, as well as a lander and rover combination.


A mock-up of the rover on display at the 2018 International Astronautical Congress. Wikimedia Commons

The orbiter's capabilities are comparable to other spacecraft already circling Mars. It packs medium and high-resolution cameras, plus radar and instruments to study Mars' magnetism and chemical composition. However, the lander/rover is the real star of the show. Once the lander touches down on solid ground, it will deploy a sophisticated, six-wheeled, solar-powered robotic rover. The 240 kg rover will travel across the Martian surface looking for evidence of life on Mars, as well as studying the Martian soil chemistry and searching for signs of past and present water. The mission's goals are similar to those of NASA's latest Mars rover, dubbed Perseverance, which is also set to launch between 30 July and 15 August. However, while NASA has recently built up a track record of successful rover landings, this will be China's maiden attempt. History has not been kind

to first-timers on Mars. Even after four previous successful landings, NASA engineers still refer to their rover landing sequences as "seven minutes of terror".


The first colour image returned from NASA's Viking I lander, taken 21 July 1976, the day after it touched down on Mars. Moon

The Red Planet is a notoriously hostile place to send a spacecraft. Humanity's first two attempts to land on Mars ended in failure. In 1971, the Soviet Union's Mars 2 spacecraft made it all the way to the surface, only to crash land. The Mars 3 mission, following right on its heels, landed on the surface, but then failed to send back a single full image. Five years later, the US made it look easy when NASA's Viking landers successfully touched, spending years returning pioneering data. However, things have not always gone smooth since then. Dozens of other Mars missions have also failed. In fact, half of all missions to Mars did not survive. Perhaps most famously, NASA's $327 million Mars Climate Orbiter turned into a fireball back in 1999. Why, you ask? One team of engineers used metric units and another used English units.

Fortunately, the odds of success have improved some recently, with NASA and other space agency's deploying a string of pioneering missions. And in 2014, India put its Mars Orbiter Mission into orbit, becoming the first country to accomplish the feat on its first attempt. However, even some recent 'successes' have been beset with problems. For example, NASA's Mars InSight lander has gathered the first direct evidence of Martian earthquakes, but it has also spent over a year trying to drill more than a couple inches beneath the Martian surface. The mission's main goal is to reach a depth of 4.8 metres.

Despite the historic difficulty of landing on Mars, China may have a leg up. In the last 10 years, China has sent two rovers to the Moon. Starting back in 2002, Chinese engineers began developing a lunar rover named Yutu, which ultimately deployed in 2010 and went on to become the longest operational lunar rover in history. In 2019, they followed that success up with the Yutu-2 rover, which became the first spacecraft to softly touch down on the far side of the Moon. For the past year and a half, Yutu-2 has been uncovering new details about the ground beneath the mysterious lunar farside. However, Mars is much farther away than the Moon. Plus, it has significantly more gravity, as well as a thin-yet-noticeable atmosphere to overcome. So, it is far harder to land on Mars than the Moon. Thankfully for China, they do not have to completely start from scratch. Their rover will also make use of lessons learned by NASA's previous Mars rovers. For instance, Tianwen-1 will land using a system of parachutes, rockets and inflatable airbags similar to what NASA has employed in the past. (Due to the enormous size of NASA's latest rovers, they now use a fascinating sky crane manoeuvre.) This also is not China's first attempt at reaching Mars. In 2011, Russia and China partnered on the Phobos-Grunt mission. The spacecraft was designed to travel to Mars and land on its Moon, Phobos, then return samples back to Earth. The mission would've also released China's first Mars spacecraft, the Yinghuo-1 orbiter. However, a malfunction left Phobos-Grunt - and the Chinese orbiter - stuck in Earth orbit. This time, they hope things will be dramatically different.

The rover's timing could not be better. It is set to arrive at perhaps the most fascinating point in the history of space exploration - as astronomers, planetary scientists, and biologists all attempt to understand the Martian environment. For decades now, scientists have known that the Red Planet once held vast oceans, and possibly life. However, a string of tantalising clues has recently surfaced suggesting that Mars' water wasn't confined to the ancient past. Rivers and lakes existed there surprisingly recently. And in some places, it appears there is even still liquid water tucked away beneath the surface today. All of this makes some astronomers suspect we' wil eventually find evidence of life on Mars, whether it be past or present.

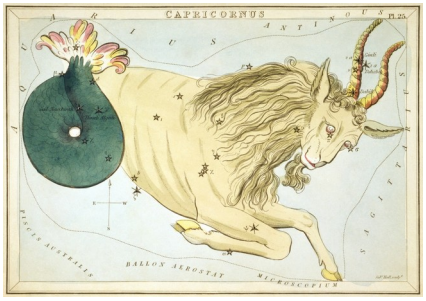
Also, now they have a good idea of where to look, too. Orbiting spacecraft, as well as NASA's Curiosity rover, have started to catch whiffs of methane gas drifting up from beneath Mars' surface in some places. On Earth, such signals can be created by microbial life. To find out the source of the methane, space agencies will have to go to these places and collect samples. For example, NASA's Perseverance rover will land in Jezero Crater, home to a former river delta, within days or weeks of Tianwen-1. Meanwhile, the Chinese orbiter will spend a few months surveying for an ideal place to land inside Utopia Planitia, according to mission scientists. The quest to solve Mars' mysteries makes the name of China's latest mission even more fitting. Tianwen comes from the title of an ancient Chinese poem, and it means 'questions to heaven'. By: Eric Betz

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

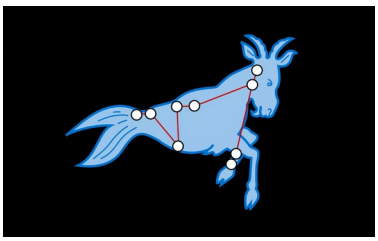
DID YOU KNOW?

Zodiac constellations 6: Capricornus

The smallest of the zodiac constellations, Capricornus represents a sea goat or a goat with a fish's tail. Its name is the Latin for 'horned goat', 'goat horn', or 'having horns like a goat's'. Although ranked 40th in size of the 88 constellations and faint, it has one of the oldest mythological associations.



It has consistently been represented as hybrid of a goat and a fish from Middle Bronze Age, the first known depiction found on a cylinder seal from ca 2,500 BCE. It was also recorded in the Babylonian star catalogue. It had three possible sources in Greek mythology. In one tale, the goat-like god Pan jumped into river, turning himself into a creature that was part fish, in order to escape the sea monster Typhron. In another, Capricornus was the goat Amalthea who suckled the infant Zeus when his mother, Rhea, saved him from being devoured by his father Cronos. The goat's broken horn transformed into a cornucopia, the horn of plenty. Thirdly, it could refer to the sea-goat Pricus, father of half-goat, half-fish creatures. Intelligent, honourable and able to speak, they were favoured by the gods. Pricus was linked to Chronos, the god of time, who made Pricus immortal and also able to manipulate time. Pricus's many children moved from the seashore to the land, becoming goats and losing their ability to think and speak. Lonely, Pricus begged Chronos to let him die, but he refused, leaving Pricusnow living indefinitely in sky as Capricornus.



One of Ptolemy's 48 constellations, it is located in an area of sky with many water-related constellations incl Aquarius, Pisces, Eridanus. This area is called 'the Sea' or 'the Water'.

The Sun passes through Capricornus from late-January to mid-February. Precession of the equinoxes means that the Sun is no longer in Capricornus during the northern hemisphere's winter solstice, as it was until 130 BCE. However, astrological Capricorn still begins with the solstice.

Notable features include:

- Alpha Capricorni: a wide pairing of unrelated stars Named Algedi, the Arabic word for 'the kid' (goat child), it is best viewd through bonoculars. (Algedi).
- Delta Capricorni: the brightest star in the constellation (Deneb Algedi). Like other stars eg Deneb, Denebola, it's na,e is the Arabic word for 'tail' for its location towards the end of the sea-goat's tail.
- M30: a modest globular cluster forming hazy patch when viewed with a telescope

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

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

COMMITTEE MEMBERS

Pierre de Villiers	(Chairperson, GPAED)	028 314 0830
Laura Norris	(Treasurer)	028 316 4453
Peter Harvey	(Secretary, sky notes)	028 316 3486
Jenny Morris	(Vice-chair, events co-ordinator, newsletter)	071 350 5560
Derek Duckitt	(Cosmology group co-ordinator, website editor)	082 414 4024
Deon Krige	(Astro-photography, youth robotics project)	028 314 1045

Non-committee members with roles:

Johan Retief	(Membership)	028 315 1132