`"The Southern Cross"

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HERMANUS ASTRONOMY CENTRE NEWSLETTER

MAY 2021

Monthly meeting This months **Zoom meeting** will take place on the evening of **Monday 17 May,** starting at **19.00.** Access details will be circulated to members closer to the time. The presenter is the amateur astronomer **Clyde Foster**, who recently discovered 'Clyde's Spot' on Jupiter. The title of his talk is '**The planets up close and personal: my journey into planetary imaging'.** See below for further details.

2021 meeting dates For your diaries. The remaining dates of the monthly meetings for 2021 are as follows: 17 May, 21 June, 19 July, 16 August, 20 September, 18 October and 15 November.

WHAT'S UP?

Moon atop the lid On 1 May, an additional attraction can be seen at the top of the most distinctive feature in the large Sagittarius constellation. Although named for the archer, a centaur with a hunting bow, from Greek mythology, the so-called 'teapot' is the signature shape in the constellation. The asterism is often oriented upside-down when observed from the southern hemisphere. The steam from the spout is created by one of the rich collections of star fields found in the constellation. This abundance is a consequence of the fact that, from Earth, the centre of the Milky Way galaxy is seen through Sagittarius. Observing the skies in and around around the 'teapot' is very rewarding. Using binoculars, it is possible to find a number of open and globular clusters and nebulae. On 1 May, the Moon will appear perched on the top of the teapot's lid, when it will occult (blocking of a celestial object by the passage of another one in front of it) of λ Sgr (lambda Sagittarii) the star which forms the apex of the lid.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the Zoom meeting on 19 April Dr Vanessa McBride, astronomer at the International Astronomical Union (IAU) Office for Astronomy Development in Cape Town, gave an excellent presentation on 'Black holes: fact or fiction?'. After describing the concept of a black hole, Vanessa gave an historical overview. The possibility of such an object dates back to 1784, but Einstein's general theory of relativity (1915) made the existence of massive objects whose gravitational effects are so strong that even light cannot escape a real possibility. She then described the different types of black holes and their evolution and characteristics in more detail. The nature of black holes means that observation and study of these objects has largely relied on indirect evidence, including electromagnetic spectra and particle detection. The

recent discovery of gravitational waves, predicted by general relativity, has now also provided direct evidence of their existence. To facilitate mathematical calculations relating to black holes they were assumed to be non-rotating. However, Vanessa stated that, in reality, black holes rotate. Much still has to be learned about them including the formation and nature of the jets which are emitted by many black holes. The presentation was supported by some amazing simulations, using the most current graphics programs.

Interest groups

Cosmology No meeting was held in April.

Astro-photography At the Zoom meeting on 12 April, visitor Pete Scully demonstrated a new image processing software program to the group.

Other activities

Educational outreach Two successful workshops were held in April, during which Grade 7 learners at Lukhanyo Primary painted the new replacement 3D models of the solar system, as part of the process of addressing the damage made by vandals to several models on the cliff path. The enthusiastic painters were ably assisted by artist Klaradyn Stemmet.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's **Zoom meeting**, will take place on the evening of **Monday 17 May,** starting at **19.00**. Access details will be circulated to members. The presenter is amateur astronomer **Clyde Foster**, who recently discovered 'Clyde's Spot' on Jupiter. The title of his presentation is '**The planets up close and personal: my journey into planetary imaging'.**

Synopsis Clyde states: 'This presentation covers my personal experiences as I developed in this field over the last 6 years, but also gives some background to amateur planetary imaging. It will also include a short segment on the story of 'Clyde's Spot' on Jupiter. I detected this relatively rare storm system on Jupiter, which was imaged by the Juno spacecraft just a few days later. NASA issued a press release which produced quite a bit of media interest.

Biography Although Clyde has had a lifelong interest in astronomy as a hobby, things changed dramatically from 2014 as he developed a passionate interest in high resolution planetary imaging. As his skills developed, his contribution to the amateur astronomical community as well as the professional planetary science community became recognised.

A specific aspect of this was his interaction with the NASA Juno mission which is currently active at Jupiter. It was whilst supporting this mission in May 2020 that he detected a new storm system on Jupiter which would become known as 'Clyde's Spot'. The presentation shares some of the experiences that Clyde has been privileged to undergo over these recent years.

A key message he wants to communicate is that we, as enthusiastic, dedicated, amateur astronomers, quietly sitting at our telescopes night after night, and most importantly, enjoying the time spent under the stars and planets, can, if so inclined, still make a serious contribution in the astronomical field.

The Centurion-based retired chemical engineer and acclaimed amateur 'backyard astronomer' is also Director of the Shallow Sky (solar system) Section of the SAAO.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting, on the evening of **Monday 3 May** will be shown **via Zoom**. Access and start time details will be circulated to members. The topic is quantum loop gravity, as proposed by Carlo Ravelli.

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 normally meets on the second Monday of each month. Members are currently communicating digitally about image processing they do at home. The next meeting will take place **via Zoom** on **Monday 10 May**.

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

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

Other activities

Stargazing While no events will take place during the coronavirus pandemic, members are encouraged to submit their own images for circulation to the membership. Please e-mail them to petermh@hermanus.co.za

FUTURE TRIPS

No outings are being planned, at present.

2021 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month. For the present, they will be presented via Zoom. The remaining dates for this year are as follows: 17 May, 21 June, 19 July, 16 August, 20 September, 18 October and 15 November.

Remaining external speakers for 2021 include Clyde Foster (May), Rob Adam (June), Lee-Anne McKinnell (July), Case Rijsdijk (September) and Pieter Kotzé (October). The other presenters are Centre members, Johan Retief and Jenny Morris. Details will be circulated closer to the time, each month.

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\

InSight tracks down the origin of two big marsquakes 6 April: NASA's InSight lander has been on the Red Planet for more than 830 Martian days, known as sols. That is a little more than one Martian year, or just over two Earth years. In that time, its Seismic Experiment for Interior Structure (SEIS) instrument has recorded more than 500 marsquakes. Most are small - less than magnitude 2 on the Richter scale - but last February, researchers reported that two of the largest quakes (magnitudes 3.6 and 3.5) had been traced back to a nearby volcanic region called Cerberus Fossae. Now, two more similarly strong quakes (magnitudes of 3.1 and 3.3), detected in March 2021, have been tied to the same region, strengthening the case that Cerberus Fossae is seismically active.

This young fossa, or shallow depression, might be a recent addition to Mars' Ceberus Fossae region. Two new marsquakes detected by the InSight lander further clinch the case for this area of Mars as a seismically active spot today. NASA/JPL/UArizona

Most of Mars' surface is a few billion years old, but Cerberus Fossae is different. It is one of the planet's youngest features, showing evidence of seismic activity within the past 2.5 million years. The region contains deep surface cracks that filled about 10 million years ago with lava, which has since been shaken up by more recent quakes. Researchers have also spotted boulders that appear to have rolled down cliffsides, perhaps knocked loose by those same not-so-ancient rumbles. The fact that four large quakes have now been traced to this region lends significant evidence to the idea that Cerberus Fossae remains seismically active. Furthermore, all of these quakes offer a key window into Mars' interior structure. That is because all four marsquakes seem more Earth-like than Moon-like, meaning they travelled more directly from their point of origin through the deeper layers of the Red Planet to reach SEIS.

However, researchers are still not sure exactly what is causing the quakes — whether they are the result of current volcanic activity (albeit beneath the surface) or more passive cooling. Such cooling is believed to cause most quakes on Mars, as the planet cools and contracts, cracking the crust. Detecting more quakes and bigger tremblors will continue to develop our picture of exactly how the Red Planet's interior behaves today. SEIS will have plenty more opportunities to catch such quakes, as InSight's mission has been approved by NASA to continue through December 2022.

March was a busy month for InSight and SEIS. Not only did the seismometer detect two large quakes, but the spacecraft also began working toward one of its next mission goals: scooping up dirt to cover the cable linking SEIS to the lander. This will insulate the cable against temperature swings, reducing noise in its data. "The seismometer is on the surface and, although protected by a shield, it does pick up wind and is exposed to big daily thermal cycles," Suzanne Smrekar, InSight's deputy principal investigator, stated last year. "Thus, we need to do careful work to remove non-seismic sources using our wind, temperature, and pressure sensors. This slows down publication of results - we don't want to interpret a glitch as a quake!" Over the course of a single sol, which lasts about 24

hours and 40 minutes, surface temperatures at InSight's location can swing between about 0 degrees Celsius during the day to –100 degrees C at night. So, covering the cable with dirt will help keep it insulated, allowing SEIS to better hear what it came for: real marsquakes.

The lander began its task on 14 March, using its steam shovel-like arm to pick up and drizzle a scoop of martian soil over SEIS' dome. That allowed the dirt to slide down the curved surface of the dome before falling on top of the cable, all without risking the robotic arm interfering with the dome's seal against the ground. The lander will now continue to drop scoop after scoop of dirt along the cable's length. With less interference from wind and weather, researchers hope the seismometer will be even more sensitive to marsquakes in the future, allowing them to more quickly identify real events as well as delve even deeper beneath the Red Planet's surface to discover what lies within.

By: Alision Klesman

Who has the right of way in space? So far, it is NASA 7 April: In January of 2020, two decommissioned satellites orbiting Earth made a really close pass. Travelling towards each other with a combined speed of 53,000 kph the two barely missed each other, coming within 65 meters between them - and perhaps as close a few meters. To make sure an event like this does not happen with any of NASA's satellites and the internet-providing Starlink satellites from SpaceX, the two groups have agreed to share information about where their spacecraft are flying — and also settled the question of who between them has the right of way. That would be NASA, according to the safety agreement, announced March 18 in a NASA press release. "SpaceX has agreed its Starlink satellites will autonomously or manually manoeuvre to ensure the missions of NASA science satellites and other assets can operate uninterrupted from a collision avoidance perspective," according to the NASA release. NASA further agrees that if a potential collision arises, it will not move spacecraft to ensure that the two satellites don't accidentally manoeuvre into each other.

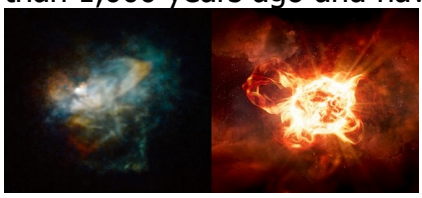
NASA

With the commercial space sector booming, the issue of avoiding satellite smash-ups in space is also going to grow. The number of satellite payloads launched in 2020 jumped to 1,261 - more than twice as many as in 2019 (522), according to statistics maintained by astrophysicist Jonathan McDowell at the Harvard-Smithsonian Center for Astrophysics. The 833 Starlink satellites that SpaceX launched last year account for most of that increase. SpaceX has continued its rapid build-up in 2021; its most recent launch of 60 more satellites was on March 23, bringing the current Starlink constellation to over 1,300 satellites.

To help address the issue, in December 2020, NASA released a handbook for aerospace companies, outlining what the agency had found to be best practices for avoiding a collision in low-Earth orbit. Measures like this guidebook and the agreement with SpaceX are just the beginning of grappling with the problem of satellite traffic management. Eventually, a more comprehensive solution will be needed, McDowell told Astronomy. "I

think these bilateral agreements are a start but in the long run there really needs to be an international 'space traffic control,'" said McDowell. By: Hailey Rose McLaughlin

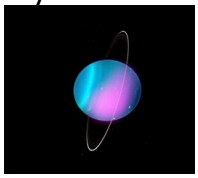
Hypergiant star VY Canis Majoris sneezes like Betelgeuse 7 April: The red hypergiant star VY Canis Majoris, 4,000 light-years distant, is in a turbulent phase near the end of its life. Wracked by pulsations, it is expelling mass in a series of dusty knots and arcs. Thanks to the high resolution of the Hubble image above, researchers were able to estimate when several of these outbursts occurred, finding they started popping off more than 1,000 years ago and have persisted until as recently as about 30 years ago.



The Hubble Space Telescope captured this image (left) of a trillion-mile-wide nebula made of material violently shed by the hypergiant star VY Canis Majoris, which is the bright white spot at upper left. The artist's concept at right shows the roiling, outburst-prone hypergiant star itself, whose surface would extend beyond Jupiter if it were to replace the Sun in our solar system. Hubble image: NASA, ESA, and R. Humphreys (University of Minnesota). Illustration: NASA, ESA, and R. Humphreys (University of Minnesota), J. Olmsted (STScI)

By comparing these timeframes to historical records of VY Canis Majoris' brightness, the team found that many of these outbursts correspond to periods when the star's brightness temporarily faded. The findings suggest VY Canis Majoris has a history of events similar to the recent dimming of another giant star, Betelgeuse. In 2019 and 2020, that star in the Orion constellation mysteriously - albeit temporarily - faded. Similar Hubble imaging suggested that Betelgeuse, too, had ejected a cloud of dust that blotted out some of its light. "VY Canis Majoris is behaving a lot like Betelgeuse on steroids," said Roberta Humphreys, an astrophysicist at the University of Minnesota in Minneapolis. She says these outbursts of material are "probably more common in red supergiants than scientists thought and VY Canis Majoris is an extreme example." By: Mark Zastrow

Chandra discovers X-rays from Uranus 8 April: Located in the outer reaches of the solar system, Uranus is a strange planet. Only one spacecraft - Voyager 2 - has ever visited, so astronomers know relatively little about the distant world. Already the odd one out by spinning on its side, now Uranus has revealed another strange feature: It is emitting X-rays, and astronomers are not sure why. They recently took a new look at observations of Uranus made by the Chandra X-ray Observatory in 2002 and 2017. Both showed X-rays coming from the seventh planet from the Sun. The image below shows X-rays detected in 2002 in pink on a visible-light image (blue and white) of the planet.



X-ray: NASA/CXO/University College London/W. Dunn et al; Optical: W.M. Keck Observatory

Researchers believe what is happening at Uranus is something that happens at Jupiter and Saturn as well. Uranus' atmosphere may simply be scattering X-rays from the Sun, rather than producing the light itself. Another possibility is that the rings are producing the X-rays, much like the rings of Saturn. Still other scientists speculate the X-rays could come

from aurorae on Uranus. However, even aurorae would be a mystery, as scientists aren't sure what could cause them on the ice giant. Because Uranus rotates on its side, its magnetic field is also tilted. This could create some complex aurorae — if they occur. For now, astronomers are hoping that Chandra may shed more light on one of the strangest planets in our solar system. By: Hailey Rose McLaughlin

There may be remnants of an ancient planet buried inside Earth 14 April: Researchers are fairly certain that we gained our favourite satellite, the Moon, after a planet, Theia, collided with the proto-Earth 4.5 billion years ago. What is not certain are the details surrounding Theia's fate. Was it a hit-and-run, or did the mantles of the two planets merge? Qian Yuan, Earth scientist at Arozona State University, and his colleagues recently suggested a new line of evidence to support the latter hypothesis, suggesting that Theia not only merged with Earth, but we may know right where the remnants of its mantle reside in Earth.

Jurik Peter/Shutterstock

"Compared to the Moon, there is much less [known] about Theia," says Yuan. "The Moon is there. You have samples. People have been there … few people care too much about the impactor." A lot of the work around the giant impact hypothesis involves comparing isotopes found on the Moon with those found on Earth. Their similarities in composition suggest that the Moon is made of a hunk of ancient Earth, meaning something like a giant impact knocked it off our Pale Blue Dot. Original models estimated that the impactor, Theia, was about the size of Mars (half the size of Earth today). Though, some recent studies suggest it might have been more like four times the size of Mars, or roughly the size of the proto-Earth. Either way, most researchers agree that the core - the densest part - of Theia merged with the core of Earth incredibly quickly after the impact, in a matter of hours.

Today, Earth's mantle is not completely uniform. About 8 percent of it is a little different from the rest, and forms two big piles near the core-mantle boundary. These two piles are called Large Low-Shear-Velocity Provinces (LLSVPs), so named because seismic waves called shear waves move about 1 or 2 percent slower when passing through them. They are huge: One is beneath the African continent, and the other under the Pacific Ocean. Some researchers think the LLSVPs slow down the shear waves because they are a higher temperature than the rest of the mantle. Others, like Yuan and his colleagues, think they are denser and compositionally different in addition to being hotter.

Yuan says he was sitting in a planetary geochemistry class when the idea struck that the LLSVPs may be related to Theia. As he tells it, he was in an ASU class, learning about the giant impact hypothesis for the formation of the Moon. Zolotov mentioned that the weakest part of the theory was the hypothetical planet Theia - no one had ever found any direct evidence to support its existence. It is totally gone. There is no evidence of it in meteorites, the asteroid belt, anywhere. When Prof Zolotov said this, Yuan recalls, "It

struck me so hard. I thought, after the impact, [Theia] would've gone into Earth. Is it possible it went into the Earth and formed the LLSVPs?"

Yuan's first move was to do some simple calculations, first comparing the size of the two LLSVPs to the size of Mars' mantle - a rough estimate for Theia's. He found the two LLSVPs were 80 or 90 percent of the size of the Mars mantle. When he added the Moon? "Almost a perfect match," he says. "So then I thought, it's not that crazy." He pulled up a 2012 Nature paper by geochemist Sujoy Mukhopadhyay at the University of California, Davis, which examined noble gas isotopes for volcanic basalts in Iceland. Mukhopadhyay had shown that Earth's mantle is heterogeneous, with at least two separate sources, and that those sources are at least 4.5 billion years old. That is, older than the Moon. "That was consistent with our hypothesis," says Yuan. One of the sources could be Theia's mantle, preserved in Earth's mantle after the impact.

Next Yuan turned to ASU astrophysicist Steven Desch, who, in 2019, had published new estimates for the composition of Theia itself. Desch, along with Katharine Robinson at the Lunar and Planetary Institute in Houston, used the composition of lunar samples from the Apollo missions to model a likely Theia, concluding it was much bigger than expected — about the size of 1 proto-Earth, or 4 Mars planets. Even more important for Yuan, Desch and Robinson estimated that Theia's mantle had a higher abundance of iron oxide than Earth's. This means it was denser, so when the two planets collided, Theia's mantle would sink. Yuan and Desch joined forces to figure out what Theia's mantle composition would have needed to look like in order for it to resemble today's LLSVPs after 4.5 billion years of mantle convection. They found that if Theia was any denser than Desch's earlier estimate, its mantle would have sank too much, forming a global layer instead of two piles. Instead, their calculations revealed the estimates for Theia's size and density were just right.

"What really stands out about [the study] is how creative it is," Susannah Dorfman, a geoscientist at Michigan State University who was not involved in the study, says. "How it connects two fields that were looking at problems in two different ways." Dorfman explains that the simulations that they ran were solid. The only place the idea could fall apart would be if the assumptions they made turned out to be incorrect, like the specific iron oxide composition of Theia and how its density compares to Earth's. Still, she says, "whenever you can get an apparently inevitable result from a certain set of starting conditions, that feels beautiful."

Yuan is the first to emphasize there's still a lot of uncertainty around the new idea. "We have to stress it's a hypothesis, and we're just proposing it for the first time," he says. "It's still very new." "I hope more researchers will test our hypothesis, to collect more evidence to either prove or disprove it," Yuan adds. He says an obvious next step is to compare the compositions of noble gas isotopes in lunar samples with that from LLSVPs. "There's no reason they would have a chemical relationship unless they inherited it from the ancestor, Theia." Dorfman says Yuan's hypothesis has already garnered lots of attention. "I watched [Yuan's] talk on YouTube," she says. "He's got 40,000 views. For a grad student talk at a conference, that's unbelievable … This is one of the things the pandemic brings us, we can reach a far greater audience." By: Anna Funk

Satellite skyglow may make it impossible to avoid light pollution 22 April: In the past few years, astronomers have raised concerns about the growing number of satellites being launched - especially the mega-constellations launched by companies like SpaceX.

When satellites streak overhead, they can disrupt naked-eye observing and astro-photography, as well as observations by professional telescopes. Even when satellites and other objects in orbit are too dim to be resolved by the naked eye, they collectively scatter enough light back into the atmosphere that it produces a diffuse glow similar to light pollution from cities. According to researchers' calculations, this light pollution from satellites and other small objects in orbit, such as debris and particles, can increase the natural sky brightness by 10 percent - a threshold that the International Astronomical Union (IAU) warned in 1979 was too high for astronomical observatories - when overhead.

The debris field around Earth is depicted in this artist's concept. Note that the size of each object is not to scale. ESA

As any astronomer knows, amateur or professional, the key to seeing much of the cosmos is dark skies. That' i why modern ground-based observatories are built in remote locations - like the Vera C. Rubin Observatory atop the peak of Cerro Pachón in Chile. It is also why many backyard observers travel far from city lights to get the best views of the sky possible. However, if artificial skyglow really brightens the atmosphere as much as this new research suggests, it could be impossible to avoid, even far from any standard sources of light pollution like streetlights. Furthermore, the number of satellites is only increasing - as will their artificial skyglow. SpaceX has already launched more than 1,300 satellites and has licenses to launch tens of thousands more. And they're not the only company in the game; Amazon is also planning their own satellite internet service for consumes.

SpaceX has responded to some of these concerns by attempting to reduce the reflectivity of its Starlink satellites. Observations by Rubin researchers found the darker satellite model is dimmer than its predecessors by about one full magnitude - down to magnitude 6.1, right at the threshold of naked-eye observation. Still, this new research shows that even when satellites are invisible to the naked eye, they can significantly brighten the background sky. As for next steps, the team's satellite skyglow calculations now need to be verified by observations. The authors write that long-term observing campaigns should be carried out at dark sites to understand how satellite mega-constellations will affect research - and everyone's ability to gaze upon the wonders of the night sky.

By: Caitlyn Buongiorno

SpaceX's (used) Crew Dragon carries another set of astronauts to orbit 23 April: Just before dawn broke at America's Space Coast this morning, spaceflight fans and area residents who woke up early were treated to an incredible sight: SpaceX's Crew Dragon - packed with four astronauts - rocketing into the sky. The Crew-2 mission will rendezvous with the International Space Station (ISS) on Saturday, 24 April. The Crew-2 launch was delayed on Thursday morning due to bad weather in the Atlantic Ocean, which could have complicated rescue efforts if they were needed. (Unlike other crew capsules that land on dry ground, SpaceX's Crew Dragon capsule lands by splashing down in water.) Friday's launch went flawlessly, with the rocket's reusable first stage landing without incident on a drone ship in the Atlantic Ocean. It was the third successful crew launch for SpaceX in less

than a year. And for the first time, the crew was flying on a rocket and capsule that had each flown before It was the third successful crew launch for SpaceX in less than a year. For the first time, the crew was flying on a rocket and capsule that had each flown before.


On Friday, 23 April, the Crew-2 mission successfully carried four astronauts into orbit aboard a Falcon 9 rocket. The launch was broadcast live on NASA TV. NASA

This crew includes NASA astronauts Megan McArthur and Shane Kimbrough, the mission's pilot and commander, as well as Japanese space agency astronaut Akihiko Hoshide and European Space Agency astronaut Thomas Pesquet. All four will spend the next six months living aboard the ISS. It is a busy time on the ISS. Last Friday, NASA astronaut Kate Rubins and Russian cosmonauts Roscosmos cosmonauts Sergey Ryzhikov and Sergey Kud-Sverchkov returned to Earth on a Soyuz capsule. In the coming weeks, the newly-arrived astronauts will replace the Crew-1 team, who are set to return home after completing the first operational flight of NASA's Commercial Crew Program. All four Crew-2 members will spend the next 6 months living aboard the ISS.


SpaceX's Crew Dragon spacecraft opens its nose cone before docking with the International Space Station in 2019. NASA

Friday's Kennedy Space Center launch marks just the third time a private company has carried humans into orbit. In the years ahead, NASA hopes these kinds of flights will become routine. After retiring the space shuttle back in 2011, the federal government charged private industry with ferrying astronauts into low-Earth orbit so NASA could focus on deep space. The Commercial Crew Program was beset by years of delays, and America has been forced to pay Russia for access to the largely American taxpayer-funded space station. Then, last May, it made history when it became the first private spacecraft to put humans into orbit, ultimately carrying two NASA astronauts safely to the ISS.. Having this many workers on the space station is already letting NASA place more focus than ever on scientific experiments in orbit. In the past, research time was limited because the space agency typically had no more than three crew members on the station at once. However,.Crew Dragon's ability to shuttle four astronauts at a time is unlocking significantly more hours to spend on science. The Crew-2 astronauts are slated to carry out more than 200 experiments during their six-month stay.

Now that SpaceX is proving itself a reliable partner, the commercial crew pressure is shifting to Boeing, which was also awarded a contract under the program to transport astronauts to the ISS. The iconic American aerospace company has yet to fly a single successful crewed flight. Boeing has scheduled their first crewed test launch for this fall, though the timeline has repeatedly slipped in recent years. Meanwhile, SpaceX is moving beyond simply carrying governmental astronauts into orbit and will soon carry space tourists, too. In conjunction with Axiom Space, a private company focused on space infrastructure and tourism, SpaceX's Crew Dragon will carry four private citizens (including

one former astronaut) to the ISS within the next year. Subject to NASA approval, the private crew will spend 8 days on the US segment of the ISS. That launch is expected to happen sometime after January 2022. By: Alison Klesman

Are exoplanets with oxygen atmospheres overrated? 27 April: Astronomers know of thousands of planets circling other stars. Although many of these worlds are bizarre beyond imagination, some are surprisingly Earth-like. So, to help search for any possible life on those planets, researchers often use so-called biosignatures as proxies. Biosignatures are substances or other clues that point to life, serving as indirect evidence of its presence. On Earth, the oxygen in our atmosphere is one of the most glaring biosignatures that an alien astronomer might notice: It's only in our atmosphere in such great quantities because photosynthesising plants and bacteria have produced it for billions of years. The biological origin of Earth's oxygen is partly why human astronomers want to search for it in the atmospheres of nearby Earth-like exoplanets, especially when long-awaited and cutting-edge facilities such as the James Webb Space Telescope come online. A new paper warns that rocky planets around Sun-like stars could develop oxygen atmospheres without any help from life at all. This means that simply detecting oxygen might not be the smoking gun researchers once thought it could be.


Astronomers looking for life on Earth-like planets, such as Kepler-452 b (seen here), may seek atmospheric oxygen as a tracer. NASA Ames/JPL-Caltech/T. Pyle

First things first: Why is oxygen not expected in the atmosphere of a lifeless rocky planet? Most oxygen in a fledgling planet's atmosphere takes the form of water, or H2O. During a Sun-like star's early years - called the pre-main sequence phase - that star emits intense ultraviolet (UV) radiation. This UV light breaks apart a planet's atmospheric water molecules, separating the hydrogen from the oxygen. The lighter hydrogen atoms then drift off into space, leaving the heavier oxygen atoms behind. Sun-like stars have particularly short pre-main sequence phases - on the order of about 50 million years. This is not enough time for the above process to yield much oxygen. Indeed, this was true of our own solar system, too. Shortly after its formation, Earth's atmosphere contained mostly nitrogen and carbon dioxide. That only changed a little over 2 billion years ago, thanks to the development of a form of life called cyanobacteria, which converts carbon dioxide to oxygen. Over the course of some 10 million years, biologically produced oxygen supplanted carbon dioxide as the second most prevalent component of Earth's air (after nitrogen). Good old O2 now makes up roughly 20 percent of Earth's atmosphere.

Based on all this, oxygen is one of the most compelling biosignatures that astronomers hope to find in the atmospheres of Earth-like exoplanets around Sun-like stars. However, this new study cautions there are cases in which oxygen can accumulate abiotically, or without the presence of life. The results are based on new computer modelling of how rocky planets like Earth evolve, morphing from their early molten stages to solid and stable bodies over the course of several billion years. Planet evolution is a complex process that depends on several factors. One very important factor is a world's initial mix of materials, which includes rock, water, and volatile elements that vaporize at relatively low temperatures (both carbon dioxide and water are considered volatiles). The researchers' model allows for different initial compositions, generating a huge range of

possible planets and atmospheres. The model also factors in geochemical processes, which can add or remove oxygen from the planet's atmosphere. This makes it more complex and comprehensive than previous models, which only consider processes that occur in the atmosphere itself.

The researchers first tested their model by trying to exactly recreate Earth. "If you run the model for Earth, with what we think was the initial inventory of volatiles, you reliably get the same outcome every time - without life you don't get oxygen in the atmosphere," said study first author Joshua Krissansen-Totton at UC Santa Cruz. When moving on to modelling planets with different initial conditions than Earth, "we also found multiple scenarios where you can get oxygen without life," Krissansen-Totton added. In fact, they found three main paths for a rocky planet to gain an oxygen-rich atmosphere without the presence of life.

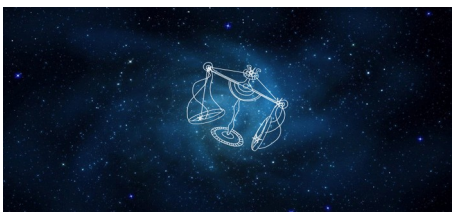
The first scenario is an Earth-like water world with oceans whose volume is 50 times (or more) greater than Earth's. All that water puts high pressure on the planet's crust, which shuts off geologic activity. This puts a stop to things like weathering and the melting of rock, which both remove oxygen from the atmosphere. The second scenario is the opposite: A dry, desert world with less than 0.3 Earth oceans effectively ends up with solidified surface and a 'steam atmosphere' of water for a period of about a million years. This ultimately provides a big reservoir of atmospheric oxygen, as sunlight breaks up the water molecules and the hydrogen escapes to space. And because the planet's solid desert surface can't remove any oxygen, it stays in the atmosphere. The final way for a lifeless planet to boast an oxygen atmosphere is if the world initially has a higher carbon dioxide-to-water ratio than early Earth. In this case, the planet experiences a runaway greenhouse effect (think Venus) and becomes too hot for oceans to form in the first place. It is also too hot for volatiles to exist in the planet's mantle, where they would otherwise sequester oxygen through chemical reactions. Instead, these volatiles stay in the atmosphere, where they're unable to remove the oxygen.

So, what is the prognosis for using oxygen as a biosignature? Fortunately, it is still pretty good. "This [study] is useful because it shows there are ways to get oxygen in the atmosphere without life, but there are other observations you can make to help distinguish these false positives from the real deal," Krissansen-Totton said. "For each scenario, we try to say what your telescope would need to be able to do to distinguish [non-biological oxygen] from biological oxygen." By: Alison Klesman

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

DID YOU KNOW?

Zodiac constellations 15: Libra

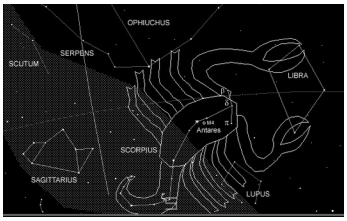


The scales' (of justice held by Virgo) form the 29th largest of the constellations. It is a fairly faint constellations, with no magnitude 1 stars.

The Sun passes through Libra during the first three weeks in November. The so-called First point of Libra is the point on celestial sphere directly opposite First point of Aries. These mark the points of the northern hemisphere autumn and spring equinoxes, respectively. The Frist pont of

Libra has right ascension at12h and a declination of 0°. It is the point at which the Sun passes from north to south of the celestial equator, on 22 or 23 September.Because of precession of the equinoxes, this point no longer lies in Libra, but moved into Virgo after 730 CE. However, both of the points have retained the names of their original constellations.

In Babylonian astronomy, Libra was linked with its two adjacent constellations. At times, it was known 'scales' or 'balance' of Birgo, the scales being sacred to the god of truth and justice. It is suggested, by some, that the scales identity was proposed because, as the Sun entered this area at equinox, day and night were equal in length. At other times, in ancient Babylon, Libra was regarded as the claws of the scorpion Scorpius. In ancient Greece, the latter notion dominated, and Libra was the claws of neighbouring Scorpius. Its Arabic name also refers to 'scorpion's claws'. However, in Roman times, its portrayal as the scales held by Astrara, the goddess of justice again prevailed.



Libra's historic dual personality continues to be reflected in its modern existence. The two brightest star names have Arabic names which mean 'northern claw' and 'southern claw'. However, its brightest stars are also described as forming a quadrangle with alpha and beta Librae representing scales balance bean and gamma and sigma the weighing pans.

Libra contains no Messier objects, while at least three stars are known to have exoplanets.

Notable features include:

- Alpha Librae (Zubenelgenubi – Arabic 'southern claw'): is the upper of the pair in the southern hemisphere. It is a wide double star easily divided with binoculars.
- Beta Librae (Zubeneschamali – Arabic)northern claw'): one of few stars to have greenish tinge. It is the brightest star in Libra.
- NGC 5897: a loose globular cluster about 50,000 ly away
- Gliese 581: a planetary system with five exoplanets

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

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