"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

AUGUST 2019

Monthly meeting This month's meeting will take place on **Monday 19 August** at the **Catholic Church Hall** starting at **19.00.** Centre member, Jenny Morris, will be presenting 'More unusual curvaceous geographical wonders of Earth'. See below for more details.

Stargazing No event is planned for August.

WHAT'S UP?

Comet 322P/SOHO This periodic comet will be at perihelion (point of an elliptical orbit nearest the Sun) and most visible on 31 August, although observation will be a challenge. Discovered in 1999, it was the first of its type discovered using the automated SOHO (Solar and Heliospheric Observatory) spacecraft telescope. The orbit of a periodic comet enables it to be observed repeatedly.. While the label applies orbital periods up to 200 years, SOHO appears much more often: every 3.99 years. As its orbital period is also under 30 years, it is further described as a short-period comet. Despite its cometary designation, SOHOs actual nature is debated. The limited length and density of its coma (tail) suggests that it is a so-called 'extinct comet' which has already lost most of its volatile ice and gases. It is probably only 100-200m in diameter. Studies have also suggested that it may, in fact, be an asteroid. Evidence for this comes from the limited evidence of a coma and the fact that it is a much denser object than the average comet. If it is actually an asteroid, SOHO is the closest approaching asteroid to the Sun.

LAST MONTH'S ACTIVITIES

Monthly centre meeting The presenter at the 15 July meeting was Kos Coronaios, Overstrand resident and well-known amateur astronomer. He spoke on 'Visitors from the Orrt Cloud, and how to observe comets'. His very interesting and informative talk began with an explanation of how comets originate in the distant area of the solar system beyond Neptune, the Kuiper Belt and, predominantly, the Oort Cloud. Despite the huge distance of the latter from the Sun, ore than 50,000 AU, solar gravity is still sufficient to pull icy objects with diameters of 4-5 km into the inner solar system. Their highly elliptical orbits bring them towards the Sun, solar heating melting the icy nucleus. The other two comet components are the coma and, sometimes, a tail, both formed from released gas and dust. Comet visibility arises from ionisation of the gas by the solar wind. When present, the tail, which is always directed away from the Sun, has 2 parts (gas and dust tails) and, sometimes a third neutral sodium trail between them.

Kos then discussed comet observation, noting that this is not an easy undertaking, as most are feint, even through telescopes, and observation usually required excellent observing conditions. Thus, it is important to make the most of easily observed comets like McNaught. Several features of comets can be classified, including degree of condensation of the coma ie level of visual density, magnitude (brightness) of the comet, size of the coma, and tail length and position angle. After then explaining how comets are labelled and named, Kos showed several of his own and other's images to illustrate the rewards obtained by determined observation of these unpredictable, but tantalising objects.

Interest groups

Cosmology At the meeting on 1 July, Pierre Hugo presented the penultimate part in the current series on 'Natural philosophy: science for non-scientists'. The topic was 'Gravity'.

Astro-photography There was no meeting in July.

Other activities

Educational outreach

Hawston Secondary School Space Cadets Weekly meetings resumed from mid-July.

Lukhanyo Youth Club Work continues on the construction of analemmatic sundials here and other schools in the Overstrand.

Stargazing No event took place in July.

THIS MONTH'S ACTIVITIES

Monthly centre meeting

This month's meeting, will take place on **Monday 19 August** at the **Catholic Hall** starting **19.00**. Centre member, Jenny Morris, will be presenting 'More unusual curvaceous geographical wonders of Earth'. She states: 'The first presentation on this topic revealed some of the wide variety and varied location of unusual curved features which are present on Earth. This sequel will present another set of such geographical features. They are located mainly on land, but can also be found underwater. As for the first set, they are all visually fascinating. Located in a dozen countries across the globe, each also has different origins and physical characteristics. They include marble chapels, the oldest living fossils, fairy circles and splashes of green in a dry desert.'

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Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting is on **Monday 5 August** at the **Catholic Hall**, starting at **19.00.** Pierre Hugo will lead the final session in the series 'Natural philosophy: science for the non-scientist'.

There is an entrance fee of R10 per person for members, R25 per person for non-members, and R10 for children, students and U3A members. For further information on these meetings, or any of the group's activities, please contact Pierre Hugo at pierre@hermanus.co.za

Astro-photography This group meets on the second Monday of each month. The next meeting will be on **Monday 12 August.** The focus will be image processing, with members discussing hardware and software compatibility.

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 Developmental work on this will resume soon.

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

Other activities

Stargazing No events have been planned for August.

FUTURE TRIPS

Planning is underway for an outing later this year. Members will be sent details once the arrangements have been made.

2018 MONTHLY MEETINGS

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

19 August	'More unusual curvaceous geographical wonders of Earth'. Presenter: Jenny Morris, Centre member
16 September	Topic 'A home observatory'. Presenter: Pierre de Villiers, Centre chairman
21 October	'Star formation and the gas cycle in galaxies'. Presenter: Dr Moses Mogotsi, SAAO., CT
18 November	'The Cassini family dynasty and their Saturnian legacy'. Presenter: Jenny Morris, centre member
9 December	TBA

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\

A second one-time fast radio burst has been traced back to its galaxy 2 July: Fast radio bursts, or FRBs, are one of astronomy's hottest topics - and biggest mysteries. These brief bursts of radio waves from outside the Milky Way typically pop off for only a

fraction of a second, then disappear forever, never to be seen again. Only two FRBs have ever been caught repeating, one of which astronomers traced back to its home galaxy in 2017. Last week, researchers reported they had, for the first time, traced a one-and-done, non-repeating FRB back to its home - the second FRB ever to be tailed to its source.

The Deep Synoptic Array-10, which spotted the burst, is located at the Owens Valley Radio Observatory. Caltech/OVRO/Gregg Hallinan

Now, less than a week later, a second team has announced they have traced a different non-repeating FRB to its home in a massive galaxy nearly 8 billion light-years away. It is only the third FRB to be tracked to its origin and the second non-repeating FRB to be traced. The new, non-repeating FRB is called FRB 190523. Astronomers led by Vikram Ravi of the Cahill Centre for Astronomy and Astrophysics in Pasadena, California, and the Centre for Astrophysics in Cambridge, Massachusetts, spotted the burst on 23 May 2019, using the Deep Synoptic Array-10's (DSA-10) ten 4.5-meter radio dishes. The burst did not repeat, they say, despite the fact that they watched it for a total of 78 hours spread out over the course of 54 days surrounding the single detection.

Once they had pinpointed the burst, the team hunted for a galaxy near its location. They found one: PSO J207.0643+72.4708 (PSO J207+72 for short), which they zoomed in on with the Keck 10-meter telescope in Hawaii. Based on their observations, PSO J207+72 is nothing like the tiny dwarf galaxy that is home to the only repeating FRB we have ever pinpointed (FRB 121102). Instead, FRB 190523's galaxy is more like the Milky Way: It contains about a trillion solar masses and is forming stars at a low rate, less than two Suns' worth per year. That is in sharp contrast to the repeater's home, which is not only a thousand times less massive, but also forming stars at a much higher rate.

Those differences are important, because they suggest two things. One: Galaxies like the Milky Way can host whatever it is that is creating the FRBs. A galaxy does not need to be forming stars rapidly to do it. Two: If the galaxies hosting FRBs are different, there may be more than one type of object causing FRBs, or maybe astronomers' original theories about their origins are wrong. The current prevailing theory is that FRBs are outbursts that occur on magnetars, which are a type of highly magnetized, rapidly spinning neutron star (neutron stars are often what is left over when a massive star reaches the end of its life and explodes). In a galaxy that is forming many stars rapidly, those stars will also die often, setting up a system where many magnetars could exist and generate FRBs. So, the host galaxy of the repeating FRB 121102 makes sense. However, galaxies like the Milky Way and FRB 190523's home are not like that – they are forming stars much more sedately, so magnetars are not as common. "The theory that FRBs come from magnetars was developed in part because the earlier FRB 121102 came from an active star-forming environment, where young magnetars can be formed in the supernovae of massive stars. But the host galaxy of FRB 190523 is more mellow in comparison," Ravi said i

How does FRB 190523 stack up against the other non-repeater, FRB 180924? Their homes look much more similar. Announced last week, FRB 180924 occurred in a galaxy called DES J214425.25−405400.81. That galaxy is 4 billion light-years away and about the mass of the Milky Way, and also forming stars at about the same rate. So, the galaxies that host the non-repeaters are pretty alike, and much more like the Milky Way than either is to the

tiny home of the repeater. That is also interesting, and lends some credence to the idea that maybe more than one factor is at play when it comes to making FRBs.

Tracking an FRB back to its home galaxy is challenging - it requires instruments with high precision to decisively show which galaxy a burst might be coming from. Also, because they are one-and-done, non-repeating FRBs are harder to trace than those that repeat. However, there are many more non-repeating FRBs known - about 80 - than repeating FRBs, of which there are only two. So, tracking non-repeaters may be harder, but it could become easier with the right instruments as more and more are found.Arrays like the full Deep Synoptic Array, which will ultimately use 10 times as many dishes as the DSA-10, and others are hoping to spot and eventually trace hundreds of FRBs per year, according to Richard Barvainis, program director of the National Science Foundation program funding the Deep Synoptic Array's construction. By: Alison Klesman

NASA's Orion successfully completes final major flight test 2 July: Today,, NASA successfully completed the final major flight test for their Orion crew capsule. This is the new craft NASA will use to transport humans to the Moon and Mars as a new age of space exploration begins.


The Orion crew capsule and its launch abort safety system lifted off on time from Cape Canaveral. NASA

The Artemis Moon mission is slated to begin next year with an uncrewed flight to the Moon. With this final flight test cleared, that should be the next major milestone in the Artemis program. Today's uncrewed test centred on the Launch Abort System (LAS), a safety system to jettison the crew capsule away from the explosive power of the main booster rocket in the event of a launch mishap. The three-minute test went off smoothly, and engineers will now comb over the collected data in greater detail.

Thanks to clear weather at Cape Canaveral in Florida, the launch went off perfectly on time. The booster rocket lifted the test craft to a height of 9,450 meters, at which point it was travelling 1,220 km per hour. Then, the test officially began, with the LAS pulling the crew capsule away from the booster at an additional 400 km/h. Once the LAS had pulled the crew capsule a safe distance from the main rocket, it flipped around to ensure that the capsule's heat shield would be pointed down for its descent. A few seconds later, the LAS released the crew capsule to allow it to fall back to Earth.

Under normal circumstances, the crew capsule would then release parachutes so it could drift safely down to a gentle splashdown in the Atlantic Ocean. However, NASA has performed neatly 50 tests of the parachute system, and decided it wasn't necessary in this case. Therefore, the capsule instead plummeted to a hard crash into the water. On its way down, it released a dozen backup data canisters, which NASA collected. Based on the live data collected, the agency is pleased. Don Reed, manager of the Orion Program's Flight Test Management Office at Johnson Space Centre in Houston, said that they "couldn't have asked for a better flight, better mission, better performance." By: Korey Haynes

Atira asteroids: A strange family of space rocks that circle close to the Sun 9 July: Astronomers have just found an asteroid circling surprisingly close to our home Sun, adding one more sibling to a rare family of space rocks.


Artist's concept depicts a near-Earth asteroid hurtling through space. NASA/JPL-Caltech

Our solar system has a lot of rubble left over from its creation that's strewn haphazardly between and beyond the planets. However, there is some order to the mess. At the outer extremes, the Oort Cloud encloses the solar system in a giant sphere made of comets that occasionally swing in for a solar visit. The Kuiper Belt, orbiting beyond Neptune, is a ring of bodies from pebble up to Pluto-sized objects of rock and ice, and the Asteroid Belt, between Mars and Jupiter, hosts a range of rocky bodies. Over the years, astronomers have logged the largest of these bodies, to make sure none are on collision paths with Earth. They have done a good job, at least with the asteroids most likely to take a turn through Earth's territory, called near-Earth objects (NEOs). However, every now and then, a surprise sneaks in.

Quanzhi Ye, an astronomer at the California Institute of Technology, recently found an asteroid half a mile across called 2019 LF6. It is one of a small family of Atira asteroids, whose orbits never stray farther from the Sun than Earth's orbit. He spotted it using the Zwicky Transient Facility, a telescope that scans wide swaths of the skies for targets that appear and disappear on short time frames – such as exploding stars and quick-moving. He and his colleagues published their finding to the International Astronomical Union's Minor Planet Centre, which catalogues such bodies, on 19 June.

Astronomers were surprised to find 2019 LF6 for two reasons. For one, astronomers thought they knew about most of the asteroids half a mile across or larger. Since 1998, NASA's NEO survey has been trying to catalogue asteroids a kilometre or larger. They also believe they have discovered over 90 percent of these large bodies. So, finding a new one in the inner solar system, relatively close to home, is somewhat of a surprise. For another, there are only 20 known Atira asteroids. LF6's orbit is elongated, bringing it sometimes closer than Mercury, and sometimes farther than Venus. It takes about 151 days to circle our home star. That's the shortest 'year' of any known asteroid. The Zwicky facility found another Atira asteroid this year named 2019 AQ3, whose orbit is only slightly longer, at 165 days. Both have orbits tilted relative to the planets in the solar system. "This suggests that sometime in the past they were flung out of the plane of the solar system because they came too close to Venus or Mercury," said researcher Tom Prince.

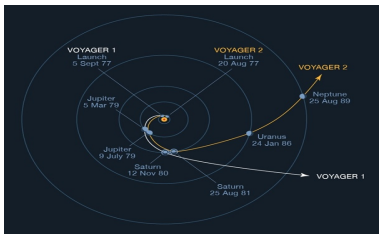
By definition, Atira asteroids have paths that stay inside Earth's track, never crossing it. However, there is always the chance that another encounter with Venus or Mercury could send them Earth's way in the future. For that reason – and for the novelty of their unusual orbits – astronomers are keen to study these Atira asteroids and see if there are any more hiding close to the Sun. By: Korey Haynes

NASA shuts off systems on Voyager 2, saving power for long haul into interstellar space 10 July: Launched in 1977, Voyagers 1 and 2 are the longest-running spacecraft, still operating at more than 11 billion miles from home, decades after the end of their nominal goal of exploring the outer solar system planets. They still get their power from the same three radioisotope thermoelectric generators, or RTGs, that have served them for years. However, with these generators yielding less power every year, the spacecraft have started to flag.

Mission controllers have had to make some tough calls about which instruments to prioritise, and recently made the call to turn off heating for Voyager 2's cosmic ray instrument. The instrument itself is still functioning for now, despite operating at conditions of -59°C, when it was only tested down to -45°C. The craft has five functioning instruments remaining, which it still uses to collect data and send back to Earth on its long journey into deep space.

The Voyager spacecraft launched in 1977 as twin spacecraft, each with ten instruments to explore space and tour the solar system, sending back humanity's first close-up look at most of the outer planets. Voyager 1 visited Jupiter and Saturn before heading for deep space, while Voyager 2 swung by those planets plus Uranus and Neptune, its trajectory carrying it off at a slower pace. Since 1989, both have been exploring the empty space beyond the planets, and returning priceless information about how far the solar atmosphere extends its influence. It was only in 2018 that Voyager 2 officially entered interstellar space, returning information on how the space environment changed as it finally left the Sun's sphere of influence.

Voyager 2 has five working instruments compared with Voyager 1's four. Most of them have been switched off intentionally, as the imaging cameras, for instance, are not useful so far from any sunlight or photographical objects. However, they are still measuring cosmic rays, magnetic fields and other charged particles that fill interstellar space far beyond the worldly realm of the planets. By measuring these particles, astronomers are learning just how far the Sun's energy extends, and how those fields interact with the interstellar medium beyond the solar system's edges.



The two Voyager spacecraft took different paths through the solar system, and both have since left the Sun's influence entirely. NASA/JPL-Caltech

It is not just the data-collecting instruments that matter on the Voyagers. For that data to be any use, they must also have working communications equipment and be able to point that equipment toward Earth for transmission. Luckily, their communications equipment is still functional. However, the thrusters that allow the spacecraft to point in a particular direction have started to degrade. In 2017, engineers turned on Voyager 1's older thrusters, ones that had not been used in 37 years. Later this month, they will try the same for Voyager 2 and the thrusters it last used at Neptune in 1989.

The mission managers for Voyager have kept the spacecraft going for decades beyond the ends of their original missions. They have pushed the instruments to new limits, and are proving that these pioneers, aged as they are, can still reveal powerful information about the cosmos. They are the farthest human-made objects in the universe, and they are still exploring and still teaching humanity about our universe. With the mission managers' continued efforts and any amount of luck, they should continue doing so for years. By: Korey Haynes

Japanese asteroid mission touches down on Ryugu, collects sample 11 July: Hayabusa2's encounters with asteroid Ryugu have been action-packed. In February, the Japanese spacecraft collected its first samples by swooping close and firing a bullet into the asteroid's surface to stir up material it then snagged with a horn-shaped collector. Then, in April, it shot a much larger impactor into Ryugu, creating an artificial crater so it could examine the material churned up from beneath the surface. On Thursday, Hayabusa2 returned to the scene of the crime and fired a second bullet, collecting material from its newly made crater.

Hayabusa2 Illustration by Akihiro Ikeshita (C), JAXA

Astronomers had not been certain they would. be able to find a safe spot to touch down in the new crater, and spent the last few months scouting the area and analysing the images Hayabusa2 sent back. The successful collection of this second sample means the mission has accomplished all its major goals, and can head back to Earth later this year on a positive note.

The mission team behind Hayabusa2 has had to work hard to get their spacecraft to finish the job it started when it launched back in 2014. Its asteroid, Ryugu, proved more jagged and rocky than mission planners had anticipated. The spacecraft must descend all the way to the surface to collect its samples, and it is not built to handle rough or uneven terrain. The engineering team found that to guarantee a safe touchdown, they had to dramatically increase the accuracy of their touchdown targeting. That took longer than they had planned, and the craft has a schedule to keep. Its mission timeline has it leaving Ryugu in December so it can bring its samples back to Earth for study. It is also a race against time, as Ryugu's surface is about to become too warm for Hayabusa2 to handle, meaning it couldn't just extend its stay indefinitely. The engineering team persevered, and Hayabusa2 has now successfully completed all its main mission objectives. It still has a few months of work left to do in orbit around Ryugu, taking pictures and measurements from afar, before it can return to Earth with its prized samples.

Hayabusa2 is just one spacecraft currently surveying an asteroid with the goal of bringing back pieces of its rocky partner. A NASA mission called OSIRIS-Rex is similarly investigating the asteroid Bennu. Astronomers often find fragments of asteroids in the form of meteorites that fall to Earth, but obtaining samples directly from space gives them a clearer picture of where and how these space rocks formed and how they have spent the past few billion years of solar system history. By: Korey Haynes

The truth is out there: Using VERITAS to search for ET 18 July: Traditionally, the hunt for intelligent life in the universe has focused on radio signals from far off worlds, but scientists are turning to more varied types of signals, as we have very little idea how a truly alien life-form might choose to communicate, either with themselves or us.


Four VERITAS telescopes, situated on Kitt Peak in Arizona, will soon be used to hunt for alien communications. VERITAS Collaboration

With that in mind, Breakthrough Lister, a program searching for signs of life in the universe, is partnering with the VERITAS (Very Energetic Radiation Imaging Telescope Array System) observatory in Arizona to look for pulses of light that might be a sign of alien intelligence. Usually, VERITAS searches the sky for gamma-ray sources, but scientists are using its multiple telescopes and sharp sight to look for even more elusive targets. "When it comes to intelligent life beyond Earth, we don't know where it exists or how it communicates," Breakthrough founder Yuri Milner said. "So, our philosophy is to look in as many places, and in as many ways, as we can. VERITAS expands our range of observation even further."

Breakthrough Listen also searches the skies at more traditional radio ranges, listening for signs of alien communication, and the project has looked for other signs of laser transmissions. Many searches focus on ensuring that observations cover as much of the sky across as much time as possible, so they do not miss any potential calls from ET. Increasingly, scientists have come to think that the ways they look for extraterrestrial life are at least as – if not more – important than broadening any individual search. This will no't be the first time VERITAS has joined in the alien hunt. In 2016, scientists used archival data from the array to look at Tabby's Star, a star with peculiar fluctuations that some postulated could be due to alien construction interfering with the star's light.

VERITAS is a collection of four telescopes, each 12m across, that look for faint flashes of light. The special light they usually search for is called Cherenkov radiation, formed when high-energy gamma-ray photons slam into Earth's atmosphere, forming the optical version of a sonic boom. The gamma rays do not typically make it through the atmosphere, but by searching for the flashes of visible Cherenkov radiation – which last only a few billionths of a second – VERITAS can tell where the gamma rays are striking Earth, and trace them back to their sources.

The Breakthrough Initiative wants to use VERITAS' large telescopes and quadruple vision to look for faint pulses of optical light that might originate from alien communications. While humans typically still use radio for space communication, NASA has also used optical laser signals to send data in space, so there is reason to think aliens may use such technology for their own purposes. The most powerful Earth lasers could deliver about 500 terawatts in just a fraction of a second. And because Breakthrough prioritizes nearby stars in its target list, VERITAS should be able to see signals from a civilization using bursts of light some 100-10,000 times fainter. By: Korey Haynes

India's Chandrayaan-2 spacecraft launches for the Moon 22 July: The Indian Space Research Organization's (ISRO) second Moon mission, Chandrayaan-2, launched successfully into Earth orbit on 22 July after a week long delay. The mission ultimately aims to place a lander and a rover on the lunar surface later this fall.

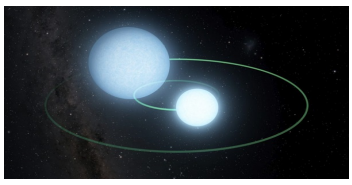
India's GSLV MkIII-M1 rocket on the launch platform before the launch in India. ISRO

At about 5:18 am EDT, India's GSLV MkIII-M1 rocket lifted off from the launch platform at the nation's Satish Dhawan Space Centre. About 16 minutes after the launch, Chandrayaan-2 successfully separated from the launch vehicle to begin its 16-day orbit around Earth before heading off to the Moon. The launch was also the first operational flight for the GSLV Mk III. Originally planned to launch on 15 July, the countdown clock was stopped with just 56 minutes to go. With an audience watching around India and the world, the launch was held in the last hour due to a 'technical snag'. That initial problem was corrected within 24 hours.

The goal of Chandrayaan-2 is to explore the rarely visited south pole region of the Moon. The mission will send an orbiter, a lander named Vikram, and the Pragyan rover to the Moon. The rover will spend 14 Earth days studying the geography and soil of the south pole. The orbiter will continue to study the region for a year. This will be the first Indian spacecraft to conduct a soft landing on the Moon, making it the fourth country to do so behind the United States, Russia (USSR), and China. Even with the week delay, the targeted landing date near the south pole of the Moon is still 7 September.

By: Hailey Rose McLaughlin

Second-fastest pair of dead stars ever found orbits every seven minutes 24 July: Astronomers using the Zwicky Transient Facility at Kitt Peak in Arizona have discovered the second-fastest orbiting pair of white dwarfs. At the end of their normal lives, our Sun and other stars like it become white dwarfs. Their outer layers puff away and leave behind a hot, dense core. If those stars started life in a binary pair, as most stars do, then then they can end up in a tight, fast orbit, as the stars age and interact.



The two white dwarf stars orbit so close together that the whole system could fit inside the planet Saturn. Caltech/IPAC

In the extreme world of binary white dwarfs, this new discovery, called ZTF J1539+5027, is an extreme case. The two tiny stars orbit each other every 6.91 minutes, within a space smaller than the planet Saturn. Researchers led by graduate student Kevin Burdge from the California Institute of Technology point out that the system will be a perfect target for the upcoming LISA gravitational wave detector, set to launch in 2034.

In their younger days, these stars probably orbited much farther apart. However, identical

twin stars are rare, and one usually starts off at least a little bigger than the other. This bigger star then races through its life a little quicker. That means that one star reaches its large and puffy phase while the other is still star-like, and they can end up sharing – or stealing – material from each other. In many cases, this trade-off forces the pair to spiral closer together. In this newly-found system, one of the stars is currently slightly larger than Earth but weighs about 60 percent the mass of our Sun. The other dwarf is puffier and a little larger in diameter but weighs only one-third of its companion. Already quite close, the two stars grow 25cm closer per day, thanks to the energy they radiate away as gravitational waves.

Such systems with clear gravitational wave emissions are expected to be common in the universe, but only a few have been positively identified so far. That may change when LISA, the Laser Interferometer Space Antenna, launches in the 2030s. Like LIGO which found colliding black holes in 2015, the instrument will hunt for the invisible ripples in space-time caused by gravitational waves. However, LISA will hunt smaller prey, like these binary systems. Unlike many of LIGO's sources, which can only be observed through gravitational waves, binary pairs like J1539 may yield extra information, appearing both through gravitational waves and visible light. By: Korey Haynes

To save the internet, Silicon Valley is sending it to space 30 July: For decades, the basic principles governing how the Internet works have remained pretty much unchanged. However, with massive growth on the horizon - thanks to everything from AI to blockchain, and from the 5G rollout to the ubiquitous Internet of Things - the amount of data we produce could eventually outpace physical storage capacity. The solution? Look to space. That is the bet companies like Amazon, Facebook, OneWeb, and other Silicon Valley darlings are wagering on. Elon Musk, CEO of SpaceX, is planning to carpet low-Earth orbit with thousands of satellites that will bring low-latency internet to all corners of the globe. Amazon is betting on a similar so-called meag-constellation worth billions, while Facebook created PointView Tech, a subsidiary to develop their secretive Athena broadband satellite, which was granted FCC approval to begin experimental trials.


The internet could one day reach every corner of the Earth courtesy of satellite constellations. sdecoret/Shutterstock

If we want to build factories on the Moon or cities on Mars - or just keep up with current data growth trends – we will need a robust internet in space, these companies predict. While networking operates very differently in zero gravity, the protocols it uses could actually be applied to terrestrial Wi-Fi as well. This symbiotic relationship may not only fix our issue with an overwhelming amount of data, it could reshape the internet itself.

If you have ever experienced an outage while streaming Netflix, it is likely due to the internet protocol suite on your home network. Technically known as TCP/IP, it works (roughly) this way: one computer sends info via a router to a second router, then to your home computer. None of this data is saved on the routers. If there is a disruption in the connection, the information is lost, and you get buffering in the middle of Black Mirror. In space, this model simply will not fly. The extreme distances and orbital variances make the TCP/IP system untenable. So, NASA scientists invented a new protocol in 1998 called

Delay Disruption Tolerant Networking, also known as the Bundle Protocol. "I think mobile apps that need to transfer data in 'spotty' connectivity would benefit from the Bundle Protocol's patience," says Vint Cerf, a co-inventor of both TCP/IP in the '60s and DTN in the '90s. Cerf is known as 'the father of the internet' and he sees not only terrestrial applications for DTN, but also views the protocol as the backbone of manned and robotic missions beyond Earth.

DTN works by sending data in bursts. This avoids errors and lags by storing information until the connection returns. And it prioritises what it sends by importance, helping further reduce latency.Another improvement is that DTN has integrity checks and encryption built in, unlike TCP/IP, making it a more secure form of internet. Considering the vulnerabilities of IoT devices - which are notoriously easy to hack - DTN promises to make the web more protected.

There are a few ways DTN is already being used. For example, reindeer herders in remote areas of Swedish Lapland do not have reliable internet access. So, a team of computer scientists tested a network using DTN protocols, allowing the Saami herders to check email and cached websites and even track their reindeer flocks. Similar experiments have taken place in Antarctica. The tactic has also been used several times in outer space. DTN was enlisted to control the Spirit and Opportunity rovers, launch a bomb at a comet and is even regularly used aboard the International Space Station. Despite that success, it has not seen broad rollout for commercial applications. At least, not yet.

On 24 May, SpaceX launched its first test of 60 Starlink satellites as part of the company's proposed mega-constellation of 12,000 small satellites. It promises to deliver high-speed, low-cost internet to every point on the globe. Musk also sees it as an essential step toward putting humans on Mars — another long-term goal for SpaceX. "We could use the Starlink structure and leverage it to put an internet system on Mars," Musk said. "We are going to need high bandwidth communications between Earth and Mars and the Starlink system will provide this."


Starlink's 60 satellites prior to release into orbit. Official SpaceX Photos

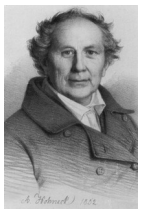
The first Starlink deployment was not without problems. The satellites caused light pollution that drew outrage from the astronomy community. Some complained that doubling the objects in Earth orbit could make it harder to see and study the heavens, and even further contribute to space junk. According to Business Insider, SpaceX lost contact with three of the satellites. They will gradually deorbit - burn up in Earth's atmosphere - over the next year. Some say these issues will likely be worked out as the projects scale. "I am not sure it is possible to speak of right or wrong at this point," Cerf says. "Something like 60 nodes have been launched for what I understand to be evaluation purposes — a prudent move before putting up thousands of satellites. There are concerns from astronomers that they will have an effect on Earth-based optical and radio astronomy. The low-Earth orbits reduce latency significantly, making satellite and terrestrial networking more similar."

Bridging the gap between internet in space and on the ground may not just be a good business prospect - it may be necessary for the survival of companies like Amazon. The mega-corporation is best known for selling toothpaste and USB sticks from warehouses, but it also sells online data storage known as cloud computing. A lot of it. According to The Verge, Amazon controls as much as 40% of the programs running in the entire cloud. That is more than Google, Microsoft and IBM combined. To keep up with the massive demand for data, Amazon may eventually have to move their servers off-planet. Bezos has said his plans for going to space will mitigate climate change and 'save the Earth'. He is not just talking server farms in low-earth orbit, but entire factories. By: Troy Farah

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

DID YOU KNOW

Astronomical catalogues Part 10: Bonner Durchmusterung and its family – included the first catalogue based on photographic images



Frederich Argelander

Bonn Observatory

David Gill

Cape Observatory

While John Herschel were working on their catalogue of deep sky objects, the Lithuanian born German astronomer Frederich Argelander (1799 – 1875) was also working on a landmark wide-survey catalogue. In 1852, he and his colleagues began a survey of northern hemisphere stars down to 9th magnitude from the observatory in Bonn.

The resulting star catalogue was published from 1859-1862 as the *Bonner Durchmusterung* (BD). 'Durchmusterung' is the German equivalent for a systematic survey. The three volumes included the position and magnitude of 324,198 stars observed from the North celestial pole to 2° South of the celestial equator. In 1863, the associated atlas was published. In 1886, an extended catalogue was published of 133,659 stars identified during observations extending to 23° South. Its associated atlas was published a year later. Many stars are still known by their BD numbers.

The scale and accuracy of the *Durchmusterung* provided material which enabled other astronomers to undertake a range of astronomical research projects, from celestial mechanics and the solar system to astrophysics. It did have one notable weakness, non-coverage of many southern hemisphere stars. This led to supplementary surveys, observations being made in Cordoba (Argentina) and Cape Town. Like the original catalogue, material in the *Cordoba Durchmesterung* (CD) was based on visual data. Covering the skies from 22° South to the South celestial pole, it included 613,953 stars down to 10th magnitude. The first four volumes were published from 1892 – 1914 and the final volume in 1932. Entries are identified by their CD prefix.

A different method was used in the *Cape Photographic Durchmusterung* (CPD). Based on the then new photographic plate technique, it was the first catalogue based on measuring photographs of the sky. Photographic images provided a valuable permanent record of the sky at the time of observation. From 1895-1900, the work was done by the then Royal Astronomer at the Cape, David Gill (the observer and photographer based at the

observatory in Cape Town) and Jacobus Kapteyn (the data analyst) in Holland. Kapteyn used statistical methods he had developed to reduce and handle large amounts of observational data. The catalogue was published from 1986 – 1900 in 3 volumes. Including stars from 18° to 90° South down to 19th magnitude, it included 454,875 stars. Items were identified by CPD number.

During the late 19th and early 20th centuries, advances in telescopic design resulted in the *Bonner Durchmusterung* exhibiting increasing problems with positional accuracy. The resulting astrometric project led to *Fundamental Catalogue,* produced at the Berlin Observatory. This provided an exact co-ordinate frame for the *Durchmusterung* and development of the *AGK c*atalogue. The BD was modernised during the 1920s and again, later, with increasing accuracy.

The *AGK* (abbreviation of *Astronomischen Gesellschaft Katalog)* was also initiated by Argelander. While the BD concentrated on general listing of stars, the focus of the AGK and its successors was maximal positional accuracy. Together, they give whole sky coverage of reference stars for calibrating photographic surveys.

The AGK covered most of sky, observed by meridian circles round the world. AGK1 was a series of catalogues, published from 1890 – 1954. AGK2, published from 1951-1958 included additional stars observed photographically from Hamburg and Bonn around 1930. It contains 185,181 stars, most to magnitude 9. The 1943 AGK2A gave the positions of 13,747 reference stars for AGK2. AGK3 and AGK3R, which included 25,499 reference stars, were published during the 1970s. The prefix AGK was retained through all catalogue versions. Complimentary to AGK3R in the northern hemisphere, the *Southern Reference Stars* (SRS) catalogue lists 20,488 southern reference stars. It is based on observations from various observatories made from 1961 – 1973.

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

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

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