`"The Southern Cross"

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HERMANUS ASTRONOMY CENTRE NEWSLETTER

FEBRUARY 2021

Monthly meeting This month, the AGM will take place, **via Zoom** on **Monday 15 February** at **19.00.** Access details will be circulated to members closer to the time.

Membership renewal for 2021
There will be no increase in fees this year.

The 2021 fees will remain at:
Member: R160
Member's spouse/partner/child, student: R80

Payment can be made in cash (directly to the Treasurer), or via online transfer. The Standard Bank details, for the latter, are as follows:
Account name – Hermanus Astronomy Centre
Account number – 185 562 531
Branch code – 051001
If you make an online donation, please reference your name and 'subs' or 'membership', or it is not possible to attribute the payment to you.

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

WHAT'S UP?

Multi-planetary dances For most of the month, early risers looking towards the East will be treated to planetary dances involving up to four planets. In the early part of the month, Venus and Saturn dance a duet. Jupiter joins to form a trio from around the 9th. A quartet is formed when Mercury joins the group around the middle of the month. All four planets can then be seen until the 20th, when Venus moves away, leaving the Saturn-Jupiter-Mercury trio to continue the dancing through the remainder of February and right through March. Groupings like these occur when two or more planets, in their individual orbits apparently gather together, when viewed from Earth. In fact, while the orbits of Mercury and Venus lie inside that of Earth, Jupiter and Saturn's orbits are a great distance beyond Earth. Furthermore, the visual illusion of planetary proximity is belied by the actual distances of these planets from Earth: ±42 million km (Venus), ±92 million km (Mercury), ±628 million km (Jupiter) and ±1,277 million km (Saturn). Venus is the brightest, due to its closeness to Earth and its bright white cloud cover. While Jupiter is much further away, and not as bright, its huge size makes it the second brightest planet, when observed from Earth.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the Zoom meeting on 18 January, Dr Ros Skelton, SALT astronomer at the SAAO in Cape Town, gave an absorbing and informative presentation on 'Cosmic crowds and crashes: exploring the effects of galaxy environment and interactions'. After outlining the size and structure of the Milky Way spiral galaxy, Ros explained how it its own dwarf galaxies (the Large and Small Magellanic Clouds) are examples of the fact that galaxies prefer company to isolation. On a larger scale, the Milky Way is part of a local group which, itself is part of a local supercluster. On a cosmic scale, galaxies are part of the filamentary structure of the cosmic web. Ros then looked at the timeline of galactic history following the Big Bang, dark matter being fundamental to galactic formation. Galactic research involves use of both optical and radio observations; in Ros's case this means the SALT telescope and the MeerKAT array. Data enables astronomers to both study and model the ways in which galaxies interact and merge. These confirm that galaxies like company and their evolution and lives involve interactions with their neighbours.

Interest groups

Cosmology There was no meeting in January.

Astro-photography There was no meeting in January.

Other activities

Educational outreach No activities took place during January.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month, the Annual General Meeting will take place, via Zoom on **Monday 15 February** at **19.00.** Access details will be circulated to members closer to the time.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting, on the evening of **Monday 1 February** 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: L19: 'Gravitomagnetism and gravitational waves' and L 20: 'Gravity's horizon: anatomy of a black hole'

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 in March.

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 dates for this year are as follows: 15 February (AGM), 15 March, 19 April, 17 May, 21 June, 19 July, 16 August, 20 September, 18 October and 15 November.

Speakers for 2021 include Dr Kechil Kirkham (March), Dr Vanessa McBride (April), Clyde Foster (May), Case Rijsdijk (September), Pieter Kotzé (October). The remaining presenters are Centre members: Pierre de Villiers, 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.

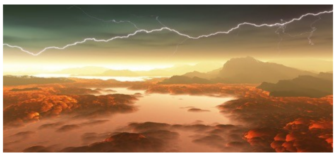
We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer,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

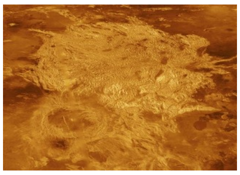
ASTRONOMY NEWS\

Venus was once more Earth-like, but climate change made it uninhabitable 5 January: We can learn a lot about climate change from Venus, our sister planet. Venus currently has a surface temperature of 450°C (the temperature of an oven's self-cleaning cycle) and an atmosphere dominated by carbon dioxide (96%) with a density 90 times that of Earth's. Venus is a very strange place, totally uninhabitable, except perhaps in the clouds some 60 kilometres up where the recent discovery of phosphine may suggest floating microbial life, but the surface is totally inhospitable. However, Venus once likely had an Earth-like climate. According to recent climate modelling, for much of its history Venus had surface temperatures similar to present day Earth . It likely also had oceans, rain, perhaps snow, maybe continents and plate tectonics, and even more speculatively, perhaps even surface life. Less than one billion years ago, the climate dramatically changed due to a runaway greenhouse effect. It can be speculated that an intensive period of volcanism pumped enough carbon dioxide into the atmosphere to cause this great climate change event that evaporated the oceans and caused the end of the water cycle.

 Artist’s rendering of the surface of Venus. Shutterstock

This hypothesis from the climate modellers inspired Sara Khawja, a master’s student), to look for evidence in Venusian rocks for this proposed change event. Since the early 1990s, a Carleton University research team - and more recently a Siberian team at Tomsk State University - have been mapping and interpreting the geological and tectonic history of Earth’s remarkable sister planet. Soviet Venera and Vega missions of the 1970s and 1980s did land on Venus and take pictures and evaluated the composition of the rocks, before the lander failed due to the hight temperature and pressure. However, our most comprehensive view of the surface of Venus has been provided by NASA’s Magellan spacecraft in the early 1990s, which used radar to see through the dense cloud layer and produce detailed images of more than 98% of Venus’s surface.

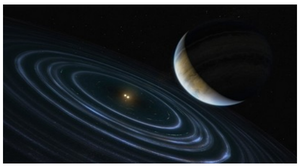
The search for geological evidence of the great climate change event led the researchers to focus on the oldest type of rocks on Venus, called tesserae, which have a complex appearance suggestive of a long, complicated geological history. They thought that these oldest rocks had the best chance of preserving evidence of water erosion, which is a such an important process on Earth and should have occurred on Venus prior to the great climate change event. Given poor resolution altitude data, they used an indirect technique to try to recognise ancient river valleys. They demonstrated that younger lava flows from the surrounding volcanic plains had filled valleys in the margins of tesserae. To their astonishment these tesserae valley patterns were very similar to river flow patterns on Earth, leading to a suggestion that these tesserae valleys were formed by river erosion during a time with Earth-like conditions. The Venus research groups at Carleton and Tomsk State universities are studying the post-tesserae lava flows for any geological evidence of the transition to extremely hot conditions.

 A portion of Alpha Regio, a topographic upland on the surface of Venus, was the first feature on Venus to be identified from Earth-based radar. NASA/JPL

In order to understand how volcanism on Venus could produce such a change in climate, we can look to Earth history for analogues. We can find analogies in super-eruptions like the last eruption at Yellowstone that occurred 630,000 years ago. However, such volcanism is small compared to large igneous provinces (LIPs) that occur approximately every 20-30 million years. These eruption events can release enough carbon dioxide to cause catastrophic climate change on Earth, including mass extinctions. To give a sense of scale, consider that the smallest LIPs produce enough magma to cover all of Canada to a depth of about 10 metres. The largest known LIP produced enough magma that would have covered an area the size of Canada to a depth of nearly eight kilometres. The LIP analogues on Venus include individual volcanoes that are up to 500 kilometres across, extensive lava channels that reach up to 7,000 kilometres long, and there are also associated rift systems - where the crust is pulling apart - up to 10,000 kilometres long. If LIP-style volcanism was the cause of the great climate change event on Venus, then could similar climate change happen on Earth? We can imagine a scenario many millions of years in the future when multiple LIPs randomly occurring at the same time could cause Earth to have such runaway climate change leading to conditions like present-day Venus.

By: Richard Ernst

Far-flung exoplanet resembles long-sought Planet Nine 12 January: An exoplanet circling two stars 336 light-years away may provide clues about where a long-sought world may be hiding in our own solar system. This strange exoplanet, HD106906 b, was first discovered in 2013 with the Magellan Telescopes at the Las Campanas Observatory in Chile's Atacama Desert. However, iin order to determine its orbit, astronomers needed the Hubble Space Telescope's clarity and precision to track the planet for 14 years. Eleven times the mass of Jupiter, HD106906 b lies incredibly far from its host stars, taking 15,000 years to complete one orbit at a distance more than 730 times that between Earth and the Sun. Not only is HD106906 b far-flung for an exoplanet, but it also sits 30 degrees off the orbital plane of the dusty disk surrounding its host stars.


HD106906 b occupies an unlikely orbit around its host stars ESA/Hubble, M. Kornmesser

"To highlight why this is weird, we can just look at our own Solar System and see that all of the planets lie roughly in the same plane," said study leader Meiji Nguyen. "It would be bizarre if, say, Jupiter just happened to be inclined 30 degrees relative to the plane that every other planet orbits in." It is possible that HD106906 b formed much closer to its twin host stars, but as it travelled through the debris disk surrounding the stars, its orbit decayed. The whirling twin stars then kicked the planet further out into the system when it migrated too close. The planet was almost entirely ejected from the system, but astronomers think a passing star might have stabilised the planet's distant orbit. Candidates for such a passing star have previously been identified using the European Space Agency's Gaia survey satellite.

Some astronomers suspect a similar scenario might have played out in our own solar system, paving the way for the hypothetical planet dubbed Planet Nine. Proposed in 2015, the gravitational influence of Planet Nine could explain the strange orbits of a unique group of Kuiper Belt objects beyond Neptune. Planet Nine has yet to be discovered (or even proven to exist), but HD106906 b's strange orbit provides a compelling parallel to what researchers predict Planet Nine's orbit would look like. Using the upcoming James Webb Space Telescope, astronomers hope to gather more data on HD106906 b to understand the planet in detail and hope to find other planets in similar orbits around other stars. By: Caitlyn Buongiorno

The history of cosmic rays is buried beneath our feet 12 January: Scientists have figured out a way to look into our galactic past and the proposed method is literally groundbreaking: It involves digging up salt crystals from miles underground. Typically, astronomers look into the past by staring deep into space and observing light that has taken billions of years to arrive from faraway galaxies and even the Big Bang itself. However, how do we study the history of something that is more nearby -- say, within the Milky Way Galaxy, which is only a hundred thousand light-years across? Or our sun, which is only eight light-minutes away? "Our Sun, for instance, is known to be much less active than similar stars. The typical sun-like star has a variation in radiation output of maybe a percent or so. For the sun, it's closer to a third of a percent," said Paul Evenson, an astrophysicist from the University of Delaware in Newark who was not involved in the study. "So, has our sun always been this quiet magnetically? That would be interesting to know." Luckily, there is another group of scientists that is used to working with this sort of time scale closer to home - geologists. Rocks on our planet, up to several billion years old, may carry marks left by cosmic rays over their lifetime, and can be analysed to reveal our galactic past.


Artist's impression of a cosmic ray and its secondary particles raining down over the Pierre Auger Observatory in Argentina. A. Chantelauze, S. Staffi, L. Bret

Cosmic rays are high energy particles whizzing through space at near the speed of light, and they pelt our planet constantly. This relentless bombardment creates a cocktail of secondary particles in the atmosphere that rains down onto the ground, and according to the new paper, leaves behind permanent marks in crystals. Not all tracks left behind by these secondary particles are useful. For instance, crystals found close to Earth's surface would contain tracks from many different sources, making them difficult to analyse. This is why one may have to dig deep. Neutrinos are among the particles created when cosmic rays hit our atmosphere. Unlike the other particles, neutrinos are so weakly interactive that they can easily pass through our entire planet without bumping into an atom. This weak interactivity of neutrinos is a double-edged sword. It makes observing neutrinos difficult, because most of them would pass right through the detector, but it also provides a unique way to screen for them - by looking for them underground, at depths where no other particles can reach.

The new study suggests that scientists should be able to figure out the intensity of cosmic rays over the past billion years by counting the tracks left by atmospheric neutrinos in deep underground crystals. Researchers could, in theory, determine the age of individual crystals using radioactive dating, then count up the neutrino tracks inside the crystals, and infer from that how the onslaught of cosmic rays has changed over time. For example, if you have two crystals of roughly the same size, with one showing 200 tracks from 1 billion years ago, and one showing 300 tracks from 1.1 billion years ago, then you would be able to say something happened during the intervening time that increased the flux of cosmic rays reaching the Earth. You would also be able to see any longer-term changes in the average influx of cosmic rays over time.

"The sources of cosmic rays are very much still an open question," said Johnathan Jordan, a physicist from the University of Michigan in Ann Arbor. "Supernova explosions are expected to constitute part of the source of cosmic rays. And then of course, the magnetic field of the sun and the earth also plays a huge role in shaping the way cosmic rays get into our atmosphere." "There are similar methods [for studying cosmic rays] using tree rings and sediments and maybe ice cores, but their time scales are in the range of a hundred thousand up to a few million years, not billions," said Evenson. Methods that look further back in time could yield data about the history of sun activity that can shed light on the long-term climate fluctuations of our planet.

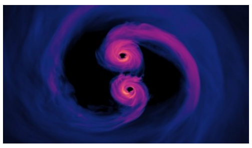
"There is this joke I often tell my students, maybe too often, which is my recipe for rabbit stew," said Evenson. "The first item in the recipe is: Catch the rabbit." The lesson, as applied to neutrino tracks, is: First find the crystals. There are existing underground labs or boreholes where researchers might locate samples, Jordan said, provided the scientists have the ability to dig up and analyse them right then and there. "Essentially, you can't bring the sample to the surface and transport it to another lab for analysis, because as soon as you bring it to the surface, it would get spoiled by all sorts of background radiation." While this may still seem somewhat doable given the number of underground labs that already exist, another matter may further complicate the logistics of the proposed experiment: For the cosmic rays within the energy range relevant to the experiment, latitude-dependent effects due to the Earth's geomagnetic field would have a significant impact.

"So, if you were to look at a sample in Japan compared to, say, somewhere in South America, you might see some very different numbers," said Thomas Gaisser, an astrophysicist also from the University of Delaware. Both Gaisser and Evenson have worked for the IceCube neutrino observatory, which uses detectors buried miles deep in the Antarctic ice to capture brief flashes produced by neutrinos. To get a good picture of the whole planet, one would ideally need samples from around the world. However, if that cannot be achieved, Jordan said, scientists can still get some idea of the local geomagnetic effects by looking at the shorter "background" tracks made by other particles, at least qualitatively.

According to the researchers' estimate, a 100-gram hunk of a one-billion-year-old salt should contain about 60,000 tracks from atmospheric neutrinos. While the number seems large, this translates to only about one track for every 16,667 years. When combined with other uncertainties such as the dating of the sample, the time resolution is even lower. While some of these uncertainties can be mitigated with larger samples, which would be more difficult to obtain and analyse, some, such as the dating uncertainty, "is going to appear no matter what," said Jordan. However, he added that the method would be useful for seeing changes over tens of millions of years, as our solar system visited different parts of the Milky Way over its 230 million year-long orbit. "We're at the stage where we're saying, 'here's the physics case for this.' But when it comes to the actual logistics of the experiments, we're not there yet," said Jordan. By: Yuen Yiu

Astronomers edge closer to detecting background 'sea' of gravitational waves

15 January: Astronomers have found the strongest evidence yet for a predicted-yet-undetected class of gravitational waves created by supermassive black holes in the cores of galaxies. They think they could have a firm detection within a couple of years.



Some galactic cores harbour two supermassive black holes. As they orbit, they generate low-frequency gravitational waves. NASA's Goddard Space Flight Centre

Gravitational waves have become one of the hottest topics in astronomy. It started some five years ago, when the LIGO and Virgo collaborations announced the very first detection of gravitational waves, which were produced by a collision of stellar-mass black holes that distorted space-time itself, sending ripples through the fabric of the cosmos. However, gravitational waves are not created only by cataclysmic, short-lived events. For instance, pairs of supermassive black holes lurking in the centres of some galaxies should also etch long-wavelength gravitational waves into space-time as they spiral toward each other. While the main bursts of short-wavelength gravitational waves from star-sized black hole collisions wash over Earth in a fraction of a second, a single wave from a duo of dancing supermassive black holes may take decades to pass us by. In fact, general relativity predicts that Earth is constantly awash in low-frequency/long-wavelength gravitational waves like these, bobbing like a buoy at sea as it rides swells coming from every direction.

A team has reported the strongest evidence yet for this background sea of gravitational waves. The researchers are part of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), a project that relies on data from the Green Bank Telescope and the now-defunct Arecibo Observatory. These massive radio telescopes observe pulsars - highly magnetic, spinning compact stars that emit beams of radio waves and rotate at hundreds of times per second. The basic premise of NANOGrav is that gravitational waves should disturb the otherwise clockwork-like pulses of pulsars. And the researchers think they're starting to see exactly that. Even though the new study does not claim a clear detection of gravitational waves, it's still "a mic drop moment," says Kelly Holley-Bockelmann, an astronomer at Vanderbilt University, who was not involved in the work. "Humanity may have just heard the background rumble of the most extreme black holes in the universe."

Previous detections of gravitational waves have come from instruments like the Laser Interferometer Gravitational-Wave Observatory (LIGO), which uses mirrors spaced 4 kilometres apart that reflect laser beams. As a short-wavelength gravitational wave washes over the giant instrument, the resulting distortion in space-time changes the apparent length of its beam by roughly 1/10,000 the diameter of a proton. LIGO can detect that change. So, to observe gravitational waves with longer wavelengths, astronomers have effectively created a galaxy-sized detector by tracking the radio signals from pulsars scattered across the Milky Way. If the space-time around Earth is stretched or compressed, the signals from pulsars should arrive slightly early or late. Furthermore, these timing variations should be correlated in a pattern characteristic of a gravitational wave, not simply random. After tracking the timing of 47 pulsars - some since 2004 - the NANOGrav team is confident they have found the first piece of the puzzle: They discovered that pulsar timings can vary by up to hundreds of nanoseconds. "We are seeing incredibly significant evidence for this signal," said NANOGrav team member Joseph Simon of the University of Colorado Boulder.

Their dataset does not yet show that that those variations are orrelated, which means the team is not yet claiming a detection of gravitational waves. However, they have been able to eliminate alternative explanations for the variations, like uncertainty in the solar system's centre of mass and interference from interstellar dust. Many astronomers think NANOGrav is on the right track, too. "The team has made meticulous observations and done some really compelling statistical analysis, so I'm convinced they're seeing something unusual," says Holley-Bockelmann. "I wouldn't bet my house that it's gravitational waves, but I would bet a very nice bottle of wine." The fact that the evidence is not yet completely clear is not too surprising, says Caltech astronomer and LIGO researcher Alan Weinstein. LIGO, he says, was "amazingly lucky - the very first signal was loud, clear, certain, and spectacular. … We expected that the first evidence would come in weakly, with uncertainty, and this is quite possibly what NANOGrav is starting to see."

More evidence should follow from similar projects, like the Parkes Pulsar Timing Array (PPTA) in Australia, which began around the same time as NANOGrav. George Hobbs of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), who leads the project, says that PPTA will present an analysis of its observations "sometime soon" with similar results. "The NANOGrav result is much more convincing than many of the false alarms that we've had in the past," he says. Still, Hobbs cautions against jumping to conclusions. "I've now had around 15 years of people saying, 'Hey, we've found gravitational waves in our data,' and so we need to be enthusiastic and cautious at the same time."

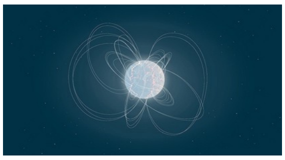
Luckily, NANOGrav already has roughly 2.5 years of additional data from both Green Bank and Arecibo - with the latter observing pulsars right up until Arecibo went offline after a cable failure in August 2020, which eventually led to the telescope's total collapse in december. The loss of Arecibo was a huge blow to NANOGrav, but the team's simulations suggest that the data they already have should be enough to reveal the timing correlations between pulsars, if they exist. Now they need to analyse it, which the team hopes to complete within the next two years, says Scott Ransom, the project's chair and a researcher at the National Radio Astronomy Observatory. If they succeed in making a detection, it would open up an entirely new area of the gravitational wave spectrum for study. "NANOGrav and LIGO complement each other wonderfully," says Weinstein. "If you compare with electromagnetic (light) observations, NANOGrav is like radio astronomy, while LIGO is like optical astronomy. They 'see' different sources."

In the case of binary supermassive black holes, astronomers hope gravitational waves will clarify the physics of how they evolve, perhaps resolving the 'final parsec problem" — the inability of theoretical models to get pairs of black holes to lose enough orbital energy to close the last few light-years of distance between them.

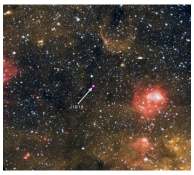

NANOGrav may use the 100m Green Bank Telescope GBO/AUI/NSF

In anticipation of such studies, and in light of Arecibo's demise, astronomers are already preparing to scale up pulsar timing array operations. NANOGrav and PPTA are partners in the international Pulsar Timing Array IPTA) - an attempt to combine observations from telescopes around the world, including a European array and China's Five-hundred-meter Aperture Spherical radio Telescope, the single largest radio dish in the world. Ransom also says NANOGrav is in "a huge amount of negotiations" with the Green Bank Observatory and its owner, the National Science Foundation, to secure more time, partially making up for the loss of Arecibo. Arecibo's collapse has also increased the urgency of getting the IPTA up and running. However, it is a painstaking task to perform analyses that combine data from that many different telescopes, each of which has their own instrumental idiosyncrasies. "They really are much more complicated, they take a lot more time, and we truly haven't had the money to have personnel dedicated to work on those," says Ransom."That's a problem." However, he adds, "if we can get the IPTA to work correctly, we are automatically about roughly a factor of two more sensitive than any individual pulsar timing array, which is huge." By: Mark Zastrow

Astronomers find the youngest, fastest spinning 'magnetar' yet 18 January: Astronomers discovered the youngest member of a bizarre group of stars, known as magnetars, using NASA's Neil Gehrels Swift Telescope in March of 2020. Now, further observations shed even more light on the exotic beast.


Artist's view of orientation of a magnetar's strong magnetic field lines. ESA

Magnetars are a special breed of already strange neutron stars. Remnants of supernovae, neutron stars are incredibly dense objects - second only to black holes - that compress more than a Sun's worth of mass into a sphere only about as wide as a city. Magnetars, however, are a subset of neutron stars that sport the universe's most powerful magnetic fields. The fields around these stars are roughly a million billion times stronger than the magnetic fields of Earth. Despite their extreme nature, astronomers have identified only 31 magnetars out of the 3,000 or so known neutron stars. So, after the discovery of J1818.0-1607 by Swift last year, researchers further observed the new object with NASA's Chandra X-ray Observatory. They found that the 31st known magnetar is even more special than they previously thought.


The magnetar J1818.0-1607 can be seen in this composite image. NASA/CXC/Univ. of West Virginia/H. Blumer; Infrared (Spitzer and Wise): NASA/JPL-CalTech/Spitzer

With follow-up observations, astronomers were able to determine that, J1818.0-1607 is located about 21,000 light-years from Earth and is the youngest known magnetar; at a mere 500 years old. "This object is showing us an earlier time in a magnetar's life than we've ever seen before, very shortly after its formation," said principle investigator Nanda Rea, when the object was first discovered. "If we understand the formation story of these objects, we'll understand why there is such a huge difference between the number of magnetars we've found and the total number of known neutron stars." Its young age is not the only unique aspect of J1818.0-1607: The star is also the fastest spinning magnetar, whirling around once every 1.4 seconds. The researchers say the magnetar's rotation rate is slowing as it ages, meaning it likely started out spinning even faster. Also, f J1818.0-1607 was not already exotic enough, it also joins a group of only five known magnetars that act like pulsars - which are fast-spinning neutron stars that emit powerful beams of radiation from their poles. "What's amazing about [magnetars] is they're quite diverse as a population," said Victoria Kaspi, director of the McGill Space Institute at McGill University in Montreal. "Each time you find one, it's telling you a different story. They're very strange and very rare, and I don't think we've seen the full range of possibilities."

By: Caitlyn Buongiorno

Astronomers want to plant telescopes on the Moon 19 January: For decades, even before the iconic Hubble telescope took flight, astronomers have been launching spacecraft into orbit in the hopes of avoiding atmospheric effects that blur images taken by telescopes on Earth. However, to catch clear signals of some cosmic objects, even those orbits aren't high enough. A group of astronomers now makes the case for assembling and planting telescopes on the Moon. They argue that our lunar neighbour, especially its far side, makes an excellent place for telescopes in the radio and infrared range. These telescopes could discover and study potentially life-friendly planets outside our solar system and explore the little-understood ‘dark ages’ of the young universe, around a million years after the Big Bang, when the first stars formed. “This is the time to start discussing projects on the Moon. There’s a huge international focus on returning to the Moon, and we wanted to make sure that science gets considered as a priority,” said Joseph Silk, a University of Oxford astrophysicist.


Artist's concept of astronauts setting up a lunar telescope array. NASA

Astronomers have already built sensitive radio telescopes on Earth, like the Low-Frequency Array (LOFAR) in Europe, but they have limits. The Earth’s upper atmosphere blocks radio signals shorter than 10 megahertz or so, limiting what the telescopes can see, said Jack Burns, a University of Colorado astronomer and director of the Network for Exploration and Space Science. Furthermore, interference from radio signals people use to communicate - including cellphones, Wi-Fi and satellites - can increasingly drown out the signals from the cosmos as these technologies become more widespread. Space telescopes can provide major improvements, but even when they’re orbiting hundreds of miles away, they can’t get away from it all. “The far side of the Moon is the only place in the inner solar system that is truly radio quiet,” said Burns. “I spent two years of my PhD developing techniques to get rid of [radio] interference,” said Jake Turner, a Cornell University astronomer who works with LOFAR and other telescopes on the ground. Turner and his colleagues are using radio astronomy to try to detect the radio signals that some planets with magnetic fields emit.

Only some planets have magnetic fields, Turner said, depending on the planet’s internal structure, and their presence or absence could be a major factor determining whether life might flourish there. Many of the planets outside our solar system discovered so far closely orbit red dwarf stars, which often spew huge blobs of charged particles that could erode a planet’s protective atmosphere and harm life forms on the surface. A magnetic field would help deflect such stellar storms and protect the planet’s atmosphere from being stripped away. Turner has figured out how to detect the magnetic fields of relatively large planets, but those of smaller, Earth-sized worlds, which could be friendly to life, unfortunately emit radio waves too faint with frequencies too short to be seen through the noise in our atmosphere. A telescope placed on the far side of the Moon, however, would take advantage of the Moon itself, which would shield the telescope from almost all the radio interference from Earth.

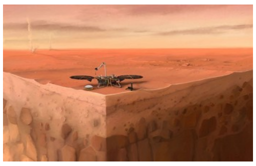
That is the idea behind a proposed mission called FARSIDE that Burns is leading. The plan is for a robotic lunar rover to set up an array of antennas that could scan the entire sky over a range of low radio frequencies. Its main objectives would include identifying life-friendly planets through their magnetic fields as well as monitoring energetic particles released by the host stars. If NASA proceeds with the project, construction of the telescope could begin in the late 2020s and be deployed soon afterwards. FARSIDE would be small and uncomplicated, not like the giant half-kilometre-wide dishes astronomers have built on Earth. However, Silk and his colleagues suggest that, further down the road, astronauts might one day assemble a large infrared telescope on the Moon. Infrared telescopes must be kept sufficiently cool so that their own infrared heat does not interfere with their operation, and this may be accomplished by locating it in a permanently shadowed site, like in a crater near the moon's south pole. Such a telescope could be used to spot faint planets and even keep an eye on their weather and seasons. When it comes to constructing such big lunar telescopes, the instruments and structures fortunately would not be affected by wind as they are on Earth, and the smaller force of gravity on the Moon would help, too, Silk said.

Even if we cannot see the far side of the Moon from Earth, astronomers are not in the dark about what it looks like: NASA's Lunar Reconnaissance Orbiter and other spacecraft periodically map out the terrain, making it possible to scope out the best spots for telescopes. Once astronomers pick an ideal landing site, they can then figure out how to transport all the necessary equipment, which needs to neatly fit in a rocket. A robot or astronauts would have to assemble the telescope, and once the instrument is up and running, it would need a satellite to transmit data to scientists on Earth. There are other challenges to making our lunar neighbour a home for telescopes. "The Moon has dust, so it's a dirty environment, and you'd have to mitigate that. The Moon also has some seismic activity, mostly due to impacts from small meteors," said Marc Postman, an astronomer at the Space Telescope Science Institute. However, there are benefits to being on the Moon, he said, and if a telescope is near a lunar base, robots or astronauts could repair or upgrade it, when needed.

Martin Elvis, a Harvard astrophysicist raises yet another problem. The Moon may have the surface area of Africa, but the prime areas that are attractive to astronomers, astronauts and would be Moon-miners -- like the Peaks of Eternal Light on the south pole -- are rather small. While the place does not have the cultural significance of Hawaii's Mauna Kea, it could become just as crowded. "There will be disputes sooner than you think," he said. Astronomers like Burns and his team hope to surmount some of these ethical and logistical challenges by working and sharing costs with NASA's Artemis program, which is planning missions to bring landers, rovers and eventually humans to the Moon. A half-century after astronauts first made boot prints on the Moon, a new generation could set up camp there, bringing their scopes with them. By: Ramin Skibba

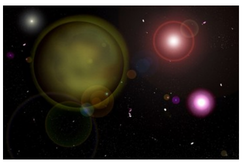
Exhausted, NASA's Martian mole finally quits digging 20 January: Mars is a harsh world compared to Earth - and even robots struggle to thrive there. One such example is the small heat probe that recently ventured to the Red Planet with NASA's InSight lander. The probe, appropriately dubbed the 'mole', was designed to burrow 5 meters into the Martian surface, where it would then collect unprecedented data on the planet's internal temperature. Equipped with that knowledge, scientists had hoped to gain a better understand of what's driving the Red Planet's geology and evolution. After its deployment in February 2019, the mole immediately struggled to gain traction in the martian soil. And the project team has been tirelessly working to #SaveTheMole ever since. Now, two years later, they have finally thrown in the towel.

The mole's troubles ultimately boiled down to the fact that InSight landed at a site that had unexpected soil properties, which quickly threw a wrench into the original plan. Unlike soil previously seen on Mars, what the mole was trying to dig through had a tendency to clump - a strange characteristic that researchers have spent the past two years trying to figure out. One of the ways engineers attempted to overcome this unforeseen hurdle was to use InSight's robotic arm in a way that has never been tried before. With no other options, the team tried using the arm to push down on probe to help it start digging. On 9 January, the team put in their final effort. Using InSight's robotic arm, they scrapped soil onto the probe, tamping it down in the hopes of providing it with more friction. The mole then hammered the ground 500 times in an effort to drive itself deeper. However, in the end, the team was forced to halt their efforts after the probe only burrowed another 2cm.


Artist's concept of NASA's InSight lander and the mole. IPGP/Nicolas Sarter

"We've given it everything we've got, but Mars and our heroic mole remain incompatible," said InSight's principal investigator Tilman Spohn of the German Aerospace Centre. InSight, however, was the very first mission to attempt to burrow into Mars' soil. And while it may have failed its primary mission, it still gained insights that will benefit both future rovers and astronauts alike. "This is why we take risks at NASA - we have to push the limits of technology to learn what works and what doesn't," said Thomas Zurbuchen, associate administrator for science at the NASA's headquarters in Washington. "In that sense, we've been successful: We've learned a lot that will benefit future missions to Mars and elsewhere" By: Caitlyn Buongiorno

Why the recent signal that appeared to come from Proxima Centauri almost certainly did not 25 January: On 29 April 2019, the Parkes Radio Telescope in Australia began listing to the radio signals from the Sun's nearest neighbour, Proxima Centauri, just over 4 light years away. The telescope was looking for evidence of solar flares and so listened for 30 minutes before retraining on a distant quasar to recalibrate and then pointing back. In total, the telescope gathered 26 hours of data. When astronomers analysed it in more detail, they noticed something odd - a single pure tone at a frequency of 982.02 MHz that appeared five times in the data. The signal was first reported last year in *The Guardian*, a British newspaper. The article raised the possibility that the signal may be evidence of an advanced civilization on Proxima Centauri, a red dwarf star that is known to have an Earth-sized planet orbiting in its habitable zone. Researchers have consistently played down this possibility saying that, at the very least, the signal must be observed again before any conclusions can be drawn. Indeed, the signal has not been seen again, despite various searches. Now, Amir Siraj and Abraham Loeb from Harvard University in Cambridge, Massachusetts, have calculated the likelihood that the signal came from a Proxima Centauri-based civilization, even without another observation. They say the odds are so low as to effectively rule out the possibility - provided the assumptions they make in their calculations are valid.


Alex Farias/Shutterstock

The new signal was found by researchers at the Breakthrough Listen project, an international collaboration of astronomers searching for evidence of extraterrestrial intelligence and funded by the billionaire Yuri Milner. They called the signal Breakthrough Listen Candidate 1 or BLC1. The signal is interesting because narrowband tones do not generally occur in nature, which instead tends to produce broadband noise. However, BLC1 has all the characteristics of a technosignature - one that originates from a technologically-capable civilization. By far the most likely origin is Earth. Most signals of this kind are quickly attributed to radio interference from nearby mobile phones, microwave ovens, passing cars, aircraft and satellites and the like. The team analysing this signal have yet to find an obvious source. They say the frequency of the signal drifts slightly over time, a phenomenon consistent with a signal from a rotating or orbiting body. This has increased the intrigue. So the work of Siraj and Loeb is timely. Their approach is based on the Copernican Principle, the idea that the Earth has no privileged place in the universe and is at no special time, so that observations made from here are no more unusual than observations made anywhere else in the universe.

This principle has a storied past. It is named after the 14th century astronomer Nicolaus Copernicus, who suggested that the Earth did not sit at the centre of the universe and instead orbited the Sun. Almost 30 years ago, the astronomer Richard Gott used the same principle to show with 95 percent confidence that our species is likely to survive for at least 200,000 years but no more than 8 million years. The basic idea is that humanity had a beginning and will eventually come to an end. We currently sit somewhere on the timeline in between but at no special place or time, not particularly near the beginning or the end. In mathematical terms, we are unlikely to be in the first 2.5 per cent of humanity's existence nor in the final 2.5 per cent. So with 95 percent confidence, we must be in the middle. Then it is just a question of slotting in the numbers. We know our species is about 200,000 years old which must be at least 2.5 per cent of the total. That suggests with 95 per cent confidence that humanity should be around for at least another 200,000 years but not longer than 8 million years.

Gott used the same argument to suggest that the chances of finding evidence of intelligent life elsewhere in our galaxy is tiny, even if we assume that these civilizations must exist. Given that we have only been radio-capable for just over a hundred years, the chances of this period overlapping with another civilization's similar capability is tiny. "A targeted radio search of 1,000 nearby stars is not likely to succeed," says Gott. Siraj and Loeb apply the same argument to the likelihood that our civilization's radio capability overlaps with another civilization's capability on Proxima Centauri. The numbers are not promising. They conclude that if the Breakthrough Listen Candidate 1 was produced by a technologically advanced civilization, this would violate the Copernican Principle by eight orders of magnitude. "This rules out, a priori, Breakthrough Listen Candidate 1 (BLC1) as a technological radio signal from the Alpha Centauri system," says Siraj and Loeb.

Indeed, given the huge number of potentially habitable planets in the galaxy, the idea that two neighbouring stars should host advanced civilizations at the same time seems extraordinarily unlikely, unless there are other factors at work. One is panspermia - the idea that life is seeded from space. That increases the chances of neighbouring stars hosting advanced life at the same time. However, this argument is complicated by the fact that life emerged on Earth some 4.5 billion years ago before the Sun and Proxima Centauri became neighbours. Of course, the Copernican Principle cannot rule out the possibility that the signal heard at Parkes is from another civilization. By: The Physics arXiv Blog

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

DID YOU KNOW?

Zodiac constellations 12: Cancer

'The crab' in Latin ranks 31st in size of all the constellations. It is the faintest of the zodiac constellations and, in cities, is often not visible with the naked eye.

In Babylonian astronomy, the constellations name referred to both a crab and a snapping turtle. An apparent link between these and ideas of death and passage to the underworld, were possibly the origin of these ideas in later Greek myths associated with Hercules and Hydra. The crab was also associated with death and afterlife in ancient Egypt. Around 2,000 BCE, it was a symbol of Scarab, the sacred emblem of immortality. In Greek mythology, it was Cancer, the crab, that attacked Hercules during his fight with multi-headed Hydra. It bit his foot and was crushed underfoot. Hera, sworn enemy of Hercules, placed the crab among the stars. During the 1500s, Cancer was depicted as a large crayfish/lobster, a symbol still used in Germanic cultures.

In ancient times, Cancer was the location of the Sun's most northerly position in sky. The Sun was directly overhead at 23.5° and this line of latitude was named the Tropic of Cancer. This northerly position is now in Taurus due to precession of the equinoxes, but the label has not changed. The Sun passes through Cancer for 3 weeks from late-July to mid-August. At least ten of Caner's stars are known to have exoplanets. 55 Cancri has 5 – 1 super-Earth, 4 gas giants, one of the latter in habitable zone.

Notable features include:

- Praesepe (M44): a major open star cluster also known as the Beehive or Manger cluster. It is one of the closest clusters to Earth, at a distance of 590 ly. It was one of the first objects observed by Galileo in 1609 with his new telescope. It contains about 50 bright stars and many red dwarfs (over two-thirds of the stars in the cluster). In Greek mythology, gamma and delta Cancri, located near the cluster, were seen to represent two donkeys feeding at the box shaped manger formed by four of the brightest stars in the cluster. The donkeys were those of the god Dionysus and his tutor Silenus rode on in the war against the Titans.
- M67: a smaller and denser open cluster with about 200 stars which is visible through binoculars.

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

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