"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

JANUARY 2020

We wish all our members a Happy New Year, and all the best for 2020.

Monthly meeting his month's meeting will place on **Monday 20 January** at the **Catholic Church Hall** starting at **19.00.** Centre member, John Saunders, will be talking on 'The story of British astronomer Patrick Moore: an amazing and fascinating man' . See below for further details.

Membership renewal for 2020

The 2020 fees rare unchanged and remain at:

Member: R160

Member's spouse/partner/child, student: R80

New members joining after 1 October 2018 will have membership until the end of 2019.

Payment can be made in cash (at meetings 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.

2020 meeting dates For your diaries. Meeting dates will be: 20 January, 17 February, 16 March, 20 April, 18 May, 15 June, 20 July, 17 August, 21 September, 19 October and 16 November.

WHAT'S UP?

Penumbral lunar eclipse On 10 January, the most extensive of three penumbral eclipses this year can be observed. (The others are on 5 June and 5 July). Lasting 4 hours, 4 minutes and 34 seconds, it will peak at 21.09.59. During a lunar eclipse, Earth's shadow blocks light from the Sun reaching the full Moon ie Earth passes between the Moon and Sun. Earth's shadow has two parts. The inner disc-shaped umbra obscures sunlight completely and, depending on the extent of coverage, produces total or partial eclipses. These cause notable darkening of the affected areas of the Moon. In the broader penumbra, which rings the umbra, sunlight is only partially obscured. This means that

when the Moon passes slightly north or south of the umbra, the resulting penumbral eclipses cause limited, and sometimes hardly any, noticeable darkening of the Moon.

LAST MONTH'S ACTIVITIES

Monthly centre meeting There was no meeting in December.

Interest groups

Cosmology At the meeting on 2 December, Derek Duckitt presented the next two lectures in the DVD series 'Blackholes, tides and curved spacetime: Understanding gravity presented by Prof Benjamin Schumacher of Kenyon College. The topics were L3: 'Revolution in the heavens' and L4: 'Universal gravitation'

Astro-photography There was no meeting in December.

Other activities

Educational outreach

Hawston Secondary School Space Cadets No meetings took place during the school holidays

Lukhanyo Youth Club Construction of the analemmatic sundial at Lukhanyo is complete, Work continues on others at other Overstrand schools.

Stargazing No events were scheduled during December.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's meeting, will take place on **Monday 20 January** in the **Catholic Hall** starting **19.00**. Centre member and past chariman, John Saunders will be talking on 'The story of British Astronomer Patrick Moore – an amazing and fascinating man.' Jophn sates:' Patrick Moore was the UK's most well-known and popular astronomer. His eccentricity along with his huge knowledge made him a "Must To Watch" for the BBC on all of NASA"s Apollo programmes. His TV programme 'The Sky At Night" is the longest-running TV series with the same presenter, in history.'

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. There is no meeting in January.

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 Derek Duckitt at derek.duckitt@gmail.com

Astro-photography This group meets on the second Monday of each month. The next meeting will take place on **13 January**. Members will continue discussions on image processing.

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 If arranged, details of events will be circulated to members.

FUTURE TRIPS

Members have been surveyed regarding their preferences for a destination in 2020. A decision will be made when the results have been collated.

2019 MONTHLY MEETINGS

Unless stated otherwise, meetings take place on the **third Monday** of each month at the **Catholic Church Hall**, beginning at **19.00**. Details for the first part of the year are:

20 January	'The story of British astronomer Patrick Moore: an amazing and fascinating man'. Presenter, John Saunders, Centre member
17 February	AGM
16 March	'Neutral gas in galaxies, and the MEERKAT'. Presenter: Dr Gyula Jozsa, Radio astronomer, SARAO, Cape Town
20 April	Topic: TBA Presenter: Dr Ros Skelton, SALT astronomer, SAAO, Cape Town
18 May	Topc: TBA Presenter: Dr Vanessa McBride, SAAO, CT

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.

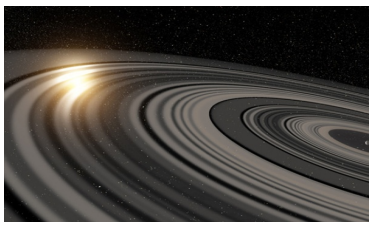
We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer,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

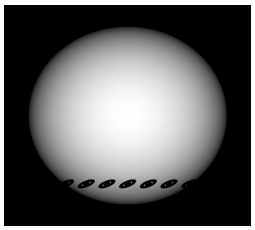
ASTRONOMY NEWS\

These so-called 'super-puff' worlds could be exoplanets with ring 2 December: As astronomers find more and more planets outside the solar system, they ae bound to come across some strange ones. They call one type of weird exoplanet 'super-puff'" because their densities seem to be far lower than even the gas giants in our solar system. Astronomers are not sure how such wispy planets could form.Now a pair of astronomers is exploring another possible explanation for the super-puff phenomenon. What if these exoplanets have rings like Saturn, which would throw off estimates of their sizes and densities?


Artist's rendering of an exoplanet called J1407b passing in front of its parent star. Some astronomers think this world may have rings. Ron Miller

The team found that rings cannot explain away all of the super-puffs found so far, but it may be able to account for some of them. Observations in the near future may be able to test whether these planets actually do have rings. Shreyas Vissapragada, a planetary astronomer at Caltech, started thinking about the possibility of super-puffs being ringed planets after another astronomer asked him about it. "If an alien observed Saturn with the Kepler space telescope, how badly would they get the density wrong if they didn't realize it had rings?" Vissapragada said he asked himself. He did the maths and found that they might calculate Saturn's density to be only half of what it really is. He teamed up with Anthony Piro, an astronomer at the Carnegie Institution for Science, to investigate what this could mean for Earth astronomers' observations.

The pair considered what the ring systems would have to be like for known super-puffs to be ringed planets. For example, most known super-puffs are fairly close to their stars, so their rings would have to be rocky rather than icy. Some of the planets wouldn't be able to have rocky rings wide enough to throw off density estimates, because rocky material that's too far from the planet would clump to form moons. For other super-puffs, rings may still be a possibility.

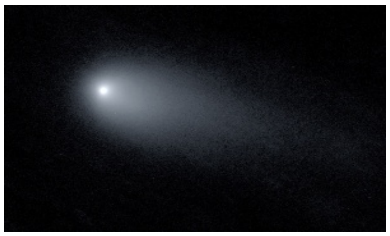

Astronomers used simulations, like this one, of a ringed exoplanet passing in front of a star to see how differently a star's light would change when eclipsed by a ringed planet or a "bare" planet. Anthony Piro and Shreyas Vissapragada

To find out whether a given exoplanet actually has rings, astronomers will have to make very precise observations as it passes in front of its star. The eclipse of a ringed planet would dim the star in a different way than the eclipse of a ringless planet. That means that, with time, careful measurements of the star dimming could reveal the presence of an exoplanet with a Saturn-like ring system. Unfortunately, there are not yet precise enough observations of most super-puffs passing in front of their stars to do this test. Observations in the near future, like astronomers hope to make with NASA's James Webb Space Telescope, the researchers said, may be able to reveal ringed exoplanets.

By: Erica K Carlson

First interstellar comet may soon break apart as it nears the Sun 2 December: In September, astronomers announced the discovery of the first interstellar comet known to have visited our solar system. Named 2I/Borisov after its Ukrainian discoverer, the comet has an extremely extended orbit - a telltale sign that its origin is from outside our solar system, beyond the Sun's influence. In the months since, astronomers have been

measuring the comet's every move as it heads toward perihelion - the point in its orbit closest to the Sun. It should make that approach in early December. By studying Borisov's movement, brightness and chemical makeup, scientists have found it is not that different from comets in our own solar system. That may also mean it could make a dramatic spectacle as it nears the Sun.


'Oumuamua, the first-known interstellar visitor, is seen venting gas and dust in this artist's concept. Another alien space rock, the first for-sure interstellar comet, Borisov, was announced in September 2019. P. Van Dokkum, G. Laughlin, C. Hsieh, S. Danieli/Yale University

The interstellar space rock was first discovered at a distance of 3 astronomical units, or AUs - with 1 AU being the average distance between the Sun and Earth. Despite being relatively bright, Borisov was not spotted earlier because of its proximity to the Sun in our line of sight. Recently, a group of astronomers took a look back through older data and found the alien comet in images from last December, where it had been overlooked. Back then, it was nearly three times as far away as it is now."By chasing this comet back as far as possible, we can have a better understanding of its inbound trajectory," said Quanzhi Ye, astronomer at the University of Maryland. "That will help us to identify its source system."

Watching Borisov as it approaches the Sun also helps astronomers understand its composition. As a comet is heated, it releases gasses, which can increase its brightness. Different gasses are released at different temperatures, so by watching for changes in brightness at various distances from the Sun, astronomers can get a rough idea of what the interstellar traveller is made of. Also, by looking at the individual wavelengths of light from the comet — its spectrum — the scientists can figure out more precisely which and how much of the compounds the space rock is releasing.

Recently, scientists reported evidence of water vapour, adding to the list that includes cyanide, hydroxide, diatomic carbon and atomic oxygen. These chemical fingerprints are useful when comparing Borisov to comets from within the solar system. "We like to think of comets as the primitive leftovers of planet formation. When we study our own comets, we're trying to understand the physics and chemistry that was occurring early in the formation of the solar system," said Adam McKay, astronomer at NASA's Goddard Space Flight Centre, "Hopefully with interstellar comets, we can understand if those are the same processes that are occurring early in the formation of other planetary systems," added McKay.

So far, Borisov, travelling through our solar system at 165,000 kph, looks a lot like other long-period comets - those that take at least 200 years to orbit the Sun. Initial studies found the alien comet has very similar red colouring to other known comets. Its size is not yet well understood, but scientists suspect the nucleus - the comet's solid core - is less than 6km across, with some estimates putting it closer to 1. These characteristics indicate that Borisov may end its solar voyage with a grand finale, since long-period comets

sometimes disintegrate as they approach the Sun due to the intense heat. Such a fate could befall our interstellar visitor, but it may also fly by unharmed. "Some comets have massive outbursts at tens of AUs from the Sun. And some comets just behave completely normally. So it's beyond anybody's guess. We will observe it every day, and if it disintegrates, if it does something crazy, we will know right away." Comet Borisov will make its closest approach to the Sun on 8 December, and will be closest to Earth on 28 December. If it survives the heat, our alien visitor is expected to quickly fade as it travels away from the Sun, becoming invisible within a few months. By: Mara Johnson-Groh

NASA's mission to the Sun is already cracking some of our star's mysteries 4 December: Scientists just released the first results from NASA's Parker Solar Probe, a mission to 'touch' the Sun. NAS launched the probe in August 2018, and it has already made a few laps around the Sun. Along the way, it has brought new insights into the Sun's outer atmosphere, as well as uncovered surprising facts about the solar wind and the Sun's magnetic fields.


NASA's Parker Solar Probe. NASA/Johns Hopkins APL/Steve Gribben

Over the next few years, the probe will swoop around the Sun several more times, getting closer to it than any spacecraft before it - close enough to fly through the corona, the streaky outer layers of the Sun that are visible during a total solar eclipse. Researchers designed the Parker Solar Probe to withstand the high temperatures near the Sun. By flying so close to our star, the probe will help scientists better understand the corona and solar wind, the particles that stream out from the Sun and throughout the solar system.

Many mysteries remain about our nearest star, like how the corona is so hot (millions of degrees, versus just a few thousand degrees at the Sun's surface) and how the Sun creates and pushes solar wind out into space. Scientists have published their initial findings from the data the probe has collected so far. Here are some highlights:

- As the solar wind blows outward, it also rotates around the Sun much faster than previously thought. The reasons for this are still unknown, but the findings may have implications for how stars slow down their spinning as they age.
- There are dramatic changes in the Sun's magnetic fields that may be depositing energy into solar wind and speeding it up.
- Part of the Sun's solar wind, dubbed 'slow solar wind', whose origins are not completely understood, seems to come at least partly from holes in the Sun's corona.
- Measurements of energetic particles travelling from the Sun along its magnetic field imply that the shape of the Sun's magnetic field could be more complex than previously thought.
- Images taken of the corona reveal a more detailed look at its structure and at how matter leaves the Sun and makes up solar wind.

These initial results show how information gathered by the Parker Solar Probe's many instruments could eventually reveal some of the Sun's remaining secrets. One of the biggest questions about the Sun's corona and solar wind has been how the Sun transports energy out into the corona, heating it to extreme temperatures and pushing solar wind to

faster speeds. Scientists have suspected that magnetic fields have something to do with it, but they did not know exactly how the Sun's magnetic fields would be carrying that energy outward.

The Parker Solar Probe saw dramatic changes in the vibrations of magnetic fields near the Sun, which seem to lose energy going outward. Though the findings aren't yet conclusive, it is possible that this could be heating the Sun's corona and accelerating solar wind. "I'm not saying we're done. But it's pretty awesome that with these first encounters, we're seeing something really new," said Justin Kasper, a University of Michigan physicist "I think it's a really good indicator that we really are going to solve these big problems with this mission." By: Erica K Carlson

Giant planet found around tiny white dwarf star, a first 4 December: For the first time, astronomers have discovered evidence for a giant planet orbiting a tiny, dead white dwarf star. Surprisingly, the Neptune-sized planet is more than four times the diameter of the Earth-sized star it orbits. "This star has a planet that we can't see directly," study author Boris Gänsicke from the University of Warwick said. "But because the star is so hot, it is evaporating the planet, and we detect the atmosphere it is losing." In fact, the searing star is sending a stream of vaporized material away from the planet at a rate of some 260 million tons per day.


This artist's concept shows the white dwarf WDJ0914+1914 and the Neptune-sized planet that orbits the dead star. ESO/M. Kornmesser

The new discovery serves as the first evidence of a gargantuan planet surviving a star's transition to a white dwarf. It suggests that evaporating planets around dead stars may be somewhat common throughout the universe. Because our Sun, like most stars, will also eventually evolve into a white dwarf, the find could even shed light on the fate of our solar system.

The white dwarf in question, dubbed WDJ0914+1914, sits about 1,500 light-years away in the constellation Cancer. Although the white dwarf is no longer undergoing nuclear fusion like a normal star, its lingering heat means it's still a blistering 25,000 deg C. That is some five times hotter than the Sun.

Researchers initially flagged the smouldering stellar core for follow-up after sifting through about 7,000 white dwarfs identified by the Sloan Digital Sky Survey. When the team analysed the unique spectra of WDJ0914+1914, they detected the chemical fingerprints of hydrogen, which is somewhat unusual. They also picked out signs of oxygen and sulphur elements they had never seen in a white dwarf before. "It was one of those chance discoveries," Gänsicke said. "We knew that there had to be something exceptional going on in this system, and [we] speculated that it may be related to some type of planetary remnant."

So, in order to get a better grasp of what was happening in the strange system, the team used the X-shooter instrument on the ESO's Very Large Telescope in Chile to carry out

follow-up observations. Based on the more detailed look, the researchers learned that the unusual elements they thought were embedded in the white dwarf were actually coming from a disk of gas churning around the dead star. "At first, we thought that this was a binary star with an accretion disk formed from mass flowing between the two stars," said Gänsicke. "However, our observations show that it is a single white dwarf with a disk around it roughly 10 times the size of our Sun, made solely of hydrogen, oxygen, and sulphur. Such a system has never been seen before, and it was immediately clear to me that this was a unique star."

After realizing just how unusual the white dwarf really was, the team shifted their focus to figuring out what the heck could create such a system. "It took a few weeks of very hard thinking to figure out that the only way to make such a disk is the evaporation of a giant planet," said Matthias Schreiber, an astronomer at the University of Valparaiso in Chile, who was vital to determining the past and future evolution of the bizarre system. Their detailed analysis of the disk's composition matched what astronomers would expect if the guts of an ice giant like Uranus and Neptune were vaporised into space.

Based on Schreiber's calculations, the white dwarf's extreme temperature means it is bombarding the nearby giant planet - which is located 0.07 astronomical unit (AU) from the star, where 1 AU is the Earth-Sun distance - with high-energy photons. This is causing the planet to lose its mass at a rate of more than 3,000 tons per second. "As the white dwarf continues to cool, the mass loss rate will gradually decrease, and become undetectable in [about 350 million years.] By then, the giant planet only will have lost "an insignificant fraction of its total mass," or about 0.04 Neptune masses.

Because the giant planet is located so close to the white dwarf, the researchers say it should have been destroyed during the stars' red giant phase. That is, unless it migrated inward after the star transitioned to a white dwarf. "This discovery is major progress because over the past two decades we had growing evidence that planetary systems survive into the white dwarf stage," said Gänsicke. "We've seen a lot of asteroids, comets, and other small planetary objects hitting white dwarfs, and explaining these events requires larger, planet-mass bodies farther out. Having evidence for an actual planet that itself was scattered in is an important step." By: Jake Parks

Jupiter's Galilean moons likely formed bit by bit from pebbles 10 December: Even in a backyard telescope, the four largest moons of Jupiter are big enough to be seen as little specks of light. While humans have known about these 'Galilean satellites' for centuries, there are still a lot of unanswered questions about how the moons formed. Now, a team of researchers has proposed a possible history for the moons that better explains more of their properties than other models could. The team suggests that the moons grew slowly by collecting pebbles, rather than larger rocks, from around an early Jupiter.

The Galilean satellites Io, Europa, Ganymede and Callisto are the four largest moons of Jupiter. NASA/JPL/DLR

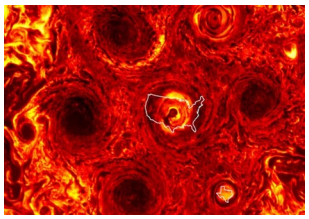
This process is like a mini version of how astronomers think our entire solar system formed, with worlds growing from pebbles to planets. In Jupiter's case, the process can account for the moons' masses, orbits, ice-to-rock ratios and differences in their internal structures. In general, researchers agree that the four Galilean moons - Io, Europa, Ganymede and Callisto - probably formed from a disk of gas that surrounded Jupiter in its infancy. However, the details of how the moons grew from this disk are not yet clear. Based on the properties of the moons they have observed and their knowledge of how disks like these behave, scientists try to paint a picture of what the objects' history might have been.

Most of the previous models of the Galilean moons' formation considered how some of the largest rocky bodies in the disk, called planetesimals, might collect chunks of rock nearly a mile wide to grow. However, the disk probably would not have made many rocks that big, because solid particles tend to drift inward. So, most would have been swallowed up by Jupiter before they had a chance to gather together and grow larger.

A group of researchers led by Yuhito Shibaike, a planetary scientist at the University of Bern, tested another idea. They calculated what could happen to planetesimals in the disk around Jupiter if they grew by collecting pebbles just a few inches or so in size instead. They found that this slow, pebble-by-pebble way of growing moons can lead to the properties we see in the Galilean satellites today, like the fact that Europa is only a few percent ice by weight, while Ganymede and Callisto are close to half rock and half ice.

"The importance of satellite formation theory, including our model, is getting larger and larger," wrote Shibaike. Shibaike says that exploring theories of how moons form will be important for future research. The European Space Agency's upcoming JUICE (JUpiter ICy moons Explorer) spacecraft is set to study the Galilean moons in great detail. And astronomers are starting to search for and understand 'exomoons' - the moons that orbit planets outside our solar system. By: Erica K Carlson

NASA's Juno probe just discovered a Texas-sized cyclone on Jupiter 12 December: Juno, a NASA spacecraft that has been orbiting Jupiter since 2016, has discovered a huge new cyclone at the gas giant's south pole. It is the sixth in what is now a hexagonal array of cyclones surrounding one central storm at the pole.

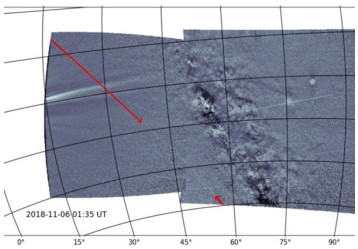

A sixth storm has been discovered churning beneath the clouds of Jupiter. NASA/JPL-Caltech/SwRI/ASI/INAF/JIRAM

The Juno spacecraft was launched in 2011 and entered orbit around Jupiter in 2016. Its primary mission is to understand how Jupiter formed and evolved over time. It is the first mission that can peer below the top layer of Jupiter's clouds. Onboard Juno is a camera that can see the infrared light Jupiter emits from within its atmosphere. This camera lets scientists track the motions of gases below the planet's surface. With this latest research, the camera has revealed complex movement in Jupiter's clouds that wa snot known before.

One of Juno's first discoveries in 2016 was a series of enormous storms arranged in a pentagon around Jupiter's south pole, with five cyclones surrounding a central one. Now, the mission has spotted a new storm that joined the fray, creating a hexagonal array of storms around the planet's south pole. The central storm is roughly the size of the continental United States, while the newest storm is about the size of Texas. The arrangement of multiple storms at the gas giant's pole was a surprise to planetary scientists. Based on simulations, they expected that a new storm popping up might trigger an episode of cannibalism, where multiple storms swallow one another to create one large vortex.

Models show these storms may not dissipate anytime soon. When astronomers were simulating these structures and changed the sizes and strengths of 'buffer zones' in the gases around the storms, the storms actually repelled each other enough to keep from merging. Their models showed how this new storm may have joined the circle of cyclones surrounding the central one without disrupting the arrangement. "The intruder becomes part of the family," Caltech planetary scientist and Juno team member Cheng Li said. Researchers don't yet fully understand what causes the peculiar arrangement of storms on Jupiter. Future observations should let them create better-informed simulations and reveal the secrets of Jupiter's polar storms. By: Erica K Carlson

NASA solar probe confirms asteroid source of Geminids meteor shower 13 December: NASA's Parker Solar Probe is starting to unlock new information about the annual Geminid meteor shower, whose origin has been a bit of a mystery to astronomers.



NASA's Parker Solar Probe spotted the source of the annual Geminid meteor shower as a faint stream of debris, seen here as a line between the red arrows. Brendan Gallagher and Karl Battams/NRL

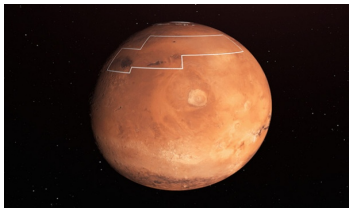
Every December, the Geminids grace the night sky with bright streaks. The Geminids are special because they are just one of two meteor showers not caused by a comet. Some astronomers suspected the nighttime display is an offspring of the asteroid Phaethon, which soars by the Sun about the same time as the meteor shower. Phaethon, being an asteroid, should not produce a meteor shower like it does. There are a lot of questions surrounding how an asteroid has a debris trail following it, and some researchers have wondered if something violent happened in the past to create the Geminids.

During its first close encounter in November 2018, the Parker Solar Probe observed faint space dust that was about 100 km wide and about 20 million km long, following Phaethon. This line of dust was in the Geminids' expected orbit, leading astronomers to believe that it was actually the Geminids, viewed from space for the first time. Because we can normally only see the meteor showers as streaks from Earth, the probe offers a new lens through which to see the showers. Once astronomers get more data on the mass and distribution of the material that makes up the Geminids dust stream, they will be able to run computer simulations to find out how the material came to be. The discovery

announcement, made on 9 December was well timed. The Geminids are expected to peak on 13 and 14 December, allowing everyone to wonder a bit more about their origin.

By: Hailey Rose McLaughlin

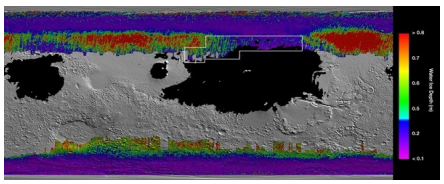
Researchers just found water ice inches below Mars' surface 16 December: Future crewed missions to Mars will be easier if astronauts can use water that is already on the Red Planet without having to bring it from Earth. Scientists know that there's ice beneath the Martian surface. How deep underground would astronauts have to dig to get it? A team of researchers has found that on large areas of Mars, ice is only inches below the surface and would be easy to get to. This gives planners of future Mars missions many options when deciding where on our neighbouring planet astronauts should land.



On large areas of Mars, including the region marked in this image, water ice lies just inches below the surface. NASA/JPL-Caltech

Past studies have shown that water ice lurks somewhere in the top 10 meters or so of Martian soil. Beyond that, they could not tell how deep the ice really is. The exact depth of the ice makes a huge difference in how easy it will be for future astronauts to get to it for water. If it is many metres deep, they would need mining equipment. If it is only a few centimetres, a simple shovel would do the trick.

A team of researchers led by Sylvain Piqueux of NASA's Jet Propulsion Laboratory found a way to deduce just how deep ice must be across the entire planet by monitoring the planet's surface temperatures across the seasons. Water ice is good at storing heat. In the summer, underground ice will tend to absorb extra heat from the ground above it, making the ground surface a bit cooler than it would have been without ice. In the winter, the ice releases some of that stored heat into its surroundings, making the ground surface a bit warmer. The more dramatic this effect, the closer to the planet's surface the ice must be. The researchers created a map of how deep ice is on the entire planet. They found that on large areas of Mars, ice is only a few inches below the surface. "It's just right there, you can scratch the surface and access it," said Piqueux.



This map shows how deep water ice lies beneath the surface of Mars. Ice is closer to the surface in regions marked in purple and blue, and deeper below the surface in areas that are coloured red. The region marked in white shows areas that may be promising landing sites for future astronauts. NASA/JPL-Caltech/ASU

Finding shallow stores of ice over large areas of the planet means future Mars missions will have many options when choosing landing sites for astronauts. Piqueux found that there's shallow ice not just near the planet's poles, but at lower latitudes as well. This is a plus for mission planning, because it's preferable to land away from the poles, and closer to the equator, when possible. It's harder to land near the poles, and the climate is harsher there.

By: Erica K Carlson

When the Milky Way erupted in 100,000 supernovae 18 December: The European Southern Observatory's Very Large Telescope in Chile has captured a new glimpse at the history of the centre of our Milky Way. Astronomers say they' hae found evidence that there was once a burst of star formation so intense that it created over 100,000 supernova explosions.


Taken with the HAWK-I instrument at the Very Large Telescope, new information is revealed about our Milky Way Galaxy. ESO/Nogueras-Lara et al.

According to the new data, the Milky Way was once what astronomers call 'a starburst galaxy'. It is an area commonly seen in other parts of the universe where stars form at a fast rate. About 80 percent of the stars in the centre of the Milky Way were formed between 8 billion and 13.5 billion years ago. But about 1 billion years ago, another intense star-formation burst happened, creating many massive new stars. These large stars live shorter lives than small stars. When large stars die, they explode. So ,the starburst led to a surge in supernovae and a dramatic period of star formation all at around the same time. "This burst of activity, which must have resulted in the explosion of more than 100,000 supernovae, was probably one of the most energetic events in the whole history of the Milky Way," said researcher Francisco Nogueras-Lara . The new data also throw out the old theory that all stars were formed at around the same time.

By: Hailey Rose McLaughlin

Betelguese's bizarre dimming has astronomers scratching their heads 27 December: Over the last few weeks, Betelgeuse, the bright reddish star in the constellation Orion, has dimmed to the faintest it has been in a century. Astronomers have been buzzing with excitement about the event, discussing the star over social media and speculating what might be going on.


Artist's impression showing a vast amount of material being flung into space from Betelgeuse. ESO/L. Calcada

The big question on everyone's mind is whether the star is about to go supernova and explode. That is probably not what's about to happen, astronomers say, but they' ae still excited to be witnessing behaviour they have never seen from Betelgeuse before. There is a lot astronomers still do not know about the variable behaviour of supergiant stars like Betelgeuse, so any strange activity is a chance to learn more about the lives of stars. For over a century, astronomers have watched Betelgeuse brighten and dim again and again. Betelgeuse is a red supergiant, a star late in its life that has expanded to an enormous size. Bubbles of material rise from inside the star to its surface and sink back down, changing the mix of hotter and cooler stuff on the star's surface. These changes make Betelgeuse appear brighter and fainter over time.

For about 25 years, Richard Wasatonic, an astronomer at Villanova University in Pennsylvania, has measured the brightness of Betelgeuse with a 10-inch diameter

telescope in his backyard. He has worked with another Villanova astronomer named Edward Guinan, as well as an amateur astronomer Thomas Calderwood. In October, they noticed that Betelgeuse was getting fainter again. By early December, they realised that Betelgeuse had become fainter than it had in the past 25 years and put ou a post on a site known as The Astronomer's Telegram to alert other astronomers. "It kept getting fainter," Guinan said. "Every night, it was fainter than the previous night, and I said, 'Well, it has to stop soon.' And it hasn't." On 23 December, they posted an update. Betelgeuse had gotten fainter still, and it was now the faintest it has been in the last century or so - for as long as astronomers have been able to measure its brightness with detectors rather than judging by eye. At its brightest, Betelgeuse is usually one of the six or seven brightest stars visible to humans in the night sky. By mid-December, it had dropped several places on that list, to 21st brightest.

The unusual dimming episode has made some astronomers wonder whether Betelgeuse is about to go supernova. Based on its mass, astronomers estimate that the supergiant will go supernova when it' i roughly 9 million years old. According to Guinan, Betelgeuse is probably between 8 and 9 million years old now. Astronomers have recently estimated that Betelgeuse may be due for a supernova in about 100,000 years, or so. When it blows, it' wil be spectacular. The explosion will be about half as bright as the full Moon, Guinan said. Anyone lucky enough to be around would be able to see it shine during the day for months until it fades away.

Astronomers have carefully observed the behaviours of many stars after they exploded as supernovae. However, no one has had a detailed look at how a star behaves leading up to a supernova. So astronomers do not really know whether the current dimming event is leading up to a supernova. What they do know is that it would be pretty unlikely for the explosion to go off now when there is so much uncertainty in their understanding of Betelgeuse's behaviour and even its age. Guinan and his team will keep monitoring Betelgeuse, as they have been for decades. Based on Betelgeuse's past dimming and brightening patterns - the star seems to cycle in brightness both every 6 years or so and every 425 days - they expect that it will get its faintest in January and then get brighter again. They will have to see if that's the case. "It defies prediction," Guinan said. "It's hard to predict what it's going to do in the future." By: Erica K Carlson

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

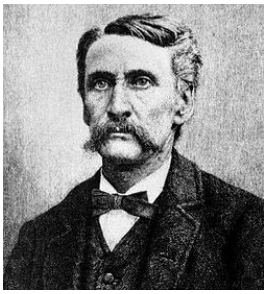
DID YOU KNOW?

Astronomical catalogues Part 15: Yerkes Oservatory catalogues – testaments to perseverance

In 1897, the University of Chicago opened the new Yerkes Observatory. It contained a 40-inch refracting telescope, the world's largest refractor used for astronomical research. Numerous prominent astronomers worked at or visited Yerkes at some time, and several specialised catalogues emerged from the impressive observations made by some of those who worked there. A few examples are outlined below.

Burnham Catalogue

Sherburne Burnham (1838 – 1921) worked for many years as a reporter, but his passion was astronomy. A dedicated astronomer, he achieved so much that he was invited to work, during his later life, a professional observatories.

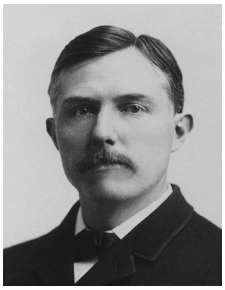


His interest was double (binary) stars. In 1873-1874, he produced his first catalogue of double stars. Observations of binary stars in Europe in the 1840s suggested that all binaries visible with current technology had been observed. However, from 1872 to 1877, with a smaller telescope, he discovered 451 new pairs. In the 1880s, these were included in the updated *General Catalogue of 1,290 Double Stars.* Access to larger instruments when he worked at Lick Observatory, California from 1888 – 1892 and Yerkes Observatory from 1897 – 1914 enabled him to discover even more binaries. Overall, he is attributed with the discovery of 1,340 double stars.

His seminal catalogue was published in 1906, the result of 36 years of work. Publication of the *Burnham Double Star Catalogue* (BDS) had not been a straightforward process. Following rejection, in 1870, by the Smithsonian Institution and damage to printing presses elsewhere, in 1874, the catalogue was eventually published by the Carnegie Institute. Its full title was *A General Catalogue of Double Stars Within 121º of the North Pole.* Part 1 included the co-ordinates, designations and magnitudes for 13,665 pairs of double stars. These were almost all the double stars discovered before 1906. Part 2 contained measures, notes and references to publications for each pair.

Publication of this comprehensive catalogues proved a stimulus to double star observation. When he retired from Yerkes in 1914, Burnham had accumulated enough material for a revision. This eventually formed part of 1932 *Aitken Double Star Catalogue* (ADS), the BDS successor.

Barnard Catalogue



Edward (EE) Barnard (1857 – 1923) also began his astronomical career as an amateur. During his lifetime, he discovered 16 comets, Barnard's galaxy (1884), Amalthea (Jovian moon) (1892), Barnard's loop, and Barnard's star (1916). Despite not completing his degree, he was employed at Lick Observatory in 1887. In 1895, he became professor of astronomy at the University of Chicago. At Yerkes, he pioneered photography of Milky Way starfields. This led to his discovery that certain dark regions in the sky were clouds of gas – dark nebulae.

In 1919, he published the *Barnard Catalogue of Dark Markings in the Sky.* It contained 182 objects, their numbering followed the Messier system, starting with Barnard 1. The series of dark objects in *Barnard's Catalogue* are known as 'Barnard objects', identified by the prefix B. In 1927, the posthumous publication of *A photographic atlas of selected regions of the Milky Way* listed 369 Barnard objects.

Ross Catalogue

Unlike Burnham and Barnard, Frank Ross (1874 – 1960) was a trained physicist. After a varied career in academia and industry, in 1924, he succeeded Barnard at Yerkes, retiring in 1939. He inherited Barnard's collection of photographic plates and decided to repeat the same series of images and compare results with a blink comparator. He discovered 379 new variable stars and over 1,000 stars of high proper motion (change in stellar position due to motion relative to the Sun). Some of the latter were found to be quite close to Earth. The result of the

1924-1939 photographic survey yielded the *Ross Catalogue of Stars with Large Proper Motion.* The so-called *Ross Catalogue* included 869 stars.. Many of these are still widely known by the catalogue number he gave them eg Ross 154.

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

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

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