"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

AUGUST 2021

NB Changed meeting start times In order to avoid load shedding interfering with Zoom meeting times, the committee has agreed that, until further notice, all HAC meetings will begin at **18.30** instead of the current 19.00.

Monthly meeting This months **Zoom meeting** will take place on the evening of **Monday 16 August,** starting at **18.30.** Access details will be circulated to members closer to the time. The presenter is retired SANSA researcher and Centre member, **Dr Pieter Kotzé.** His talk is titled '**Cosmo-Climatology: Does solar variability affect Earth's climate?**"See below for further details.

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

New 'Did you know?' series From this month a new series titled 'Solar system objects' begins. It looks at the components of the classification system currently used to group the numerous types of objects found in the solar system.

WHAT'S UP?

5 naked-eye planets From 12 – 31 August, all five naked-eye planets will be visible, after sunset. Venus, Mars and Mercury form a dancing trio towards the West while Jupiter and Saturn will be performing their own duet to the East. These five planets, and the Sun and Moon, are not just interesting in themselves. They are the reason why we have a seven-day week. Over 3 millennia ago, the ancient Babylonians were keen star-gazers and observed the five planets and the Sun and Moon carefully. They developed a lunar calendar based on a 28 day cycle, which conveniently divided into four 7-day weeks, the number seven reflecting the number of celestial objects they could observe with the naked eye. Other ancient civilisations eg Egypt, Rome developed different length weeks, but the Babylonian system remained dominant and is still in use today. Some of the day names, which were named for the seven celestial objects also persist in English eg Sunday (Sun), Monday (Moon) and Saturday (Saturn). The other days of the week are named for mythological Norse gods, a result of the historic influence of Germanic culture in Britain.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the Zoom meeting on 19 July, Dr Lee-Anne McKinnell Managing Director of SANSA Hermanus gave an informative and very interesting

presentation on 'The past, present and future of the Space Agency in Hermanus'. She noted that 2021 is both the 180th anniversary of establishment of a magnetic observatory at the Cape (1841) and the 10th anniversary of SANSA, which succeeded the Hermanus Magnetic Observatory. Her outline of the history of magnetic observations included the move to Hermanus, in 1942, from Observatory, a move necessitated by growing interference from electrification of the railways in Cape Town.

Since it became part of the National Research Foundation (NRF) in 2001, what is now SANSA has grown significantly. Staff and student numbers have grown as the facility has become an important part of the global space weather scientific community, while maintaining its long record of magnetic observations. Space weather involves observation and study of, and research into, the impact which solar activity has on Earth eg effect of solar flares and coronal mass ejections on electricity grids, communication systems and aviation. As part of the increasing role which space weather data is playing in these areas, particularly aviation, Lee-Anne gave details of the dedicated 24/7 Space Weather Centre which is currently being built at SANSA. This will replace the present small facility located in the foyer of the main building. Construction of additional staff offices and student /visitor accommodation, an auditorium and magnetically shielded generator house provides further evidence that Hermanus is home to an innovative, cutting-edge facility which is making significant contributions to science and human capital development, both locally and internationally.

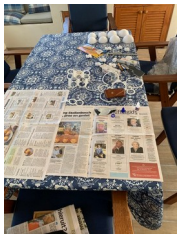
Interest groups

Cosmology At the Zoom meeting, held on 5 July, Derek Duckitt presented two videos in which the presenters proposed alternatives to dark matter.

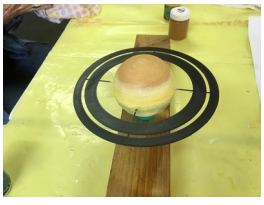
Astro-photography The meeting scheduled for 12 July had to be cancelled because of technical problems with Internet access.

Other activities

Educational outreach No activities took place during July. The last activity, which took place in April, took the form of 2 successful workshops during which Grade 7 learners at Lukhanyo Primary painted the new replacement 3D models of the solar system, as part of the process of addressing the damage made by vandals to several models on the cliff path. The enthusiastic painters were ably assisted by artist Klaradyn Stemmet.








THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's **Zoom meeting**, will take place on the evening of **Monday 16 August,** starting at **18.30**. Access details will be circulated to members.

The presenter is **Dr Pieter Kotzé.** His talk is titled '**Cosmo-climatology: Does solar variability affect Earth's climate?'**
Synopsis The Sun is a profoundly important factor in the Earth's energy budget and is by far the most important energy provider in our solar system. Although our Sun is an extremely stable star, its energy output varies on timescales ranging from seconds to several hundred years. In this presentation I am going to discuss the question 'Does solar variability affect the Earth's climate?' In addition, I will briefly discuss some secrets revealed by baobab tree rings in Southern Africa during the Maunder minimum (1650-1720) period when the Sun was exceptionally inactive.
Biography Pieter Kotzé retired last year from SANSA after a tenure of more than 30 years as a researcher in Hermanus. He is currently an extraordinary staff member of the Centre for Space Research at North-West University as well as the Department of Physics at Stellenbosch University. His current research is focussing on high-energy Astro-particle behaviour as well as time-varying spectroscopy of the Sun and Sun-like stars.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting, on the evening of **Monday 2 August** will be shown **via Zoom,** starting at **18.30**. Details of the topic and access details will be circulated to members, in due course.

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. Details of the August Zoom meeting will be circulated to members, in due course.

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**, starting at **18.30**. The remaining dates for this year are as follows: 16 August, 20 September, 18 October and 15 November.

Remaining external speakers are Case Rijsdijk (September) and Petri Vaisänen (October). Centre member presenters are Pieter Kotzé (August) and Jenny Morris (November). Details will be circulated closer to the time, each month.

ASTRONOMY GEARING'S POINT ASTRONOMY EDUCATION CENTRE (GPAED)

Municipal agreement has been obtained for this project, which is to be located within the existing whale-watching area at Gearing's Point.. Work is underway to obtain the necessary quotes and other budgetary requirements in order to submit an amended proposal to the National Lottery Commission.

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

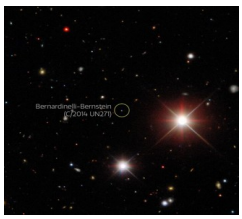
Giant comet found hidden in dark energy data 1 July: Astronomers searching through six years of images from one of the best astro-cameras in the world have just made a massive discovery - literally. Pedro Bernardinelli and Gary Bernstein, both of the University of Pennsylvania, have spotted a giant comet travelling inward from the fringes of our solar system, headed for a close encounter with the Sun in 2031. Based on the amount of light it reflects, the pair estimates the comet, called C/2014 UN271 (Bernardinelli-Bernstein), is some 100 to 200 kilometres across. That is roughly 10 times the average diameter of other known comets. The researchers also estimate Comet Bernardinelli-Bernstein is some 1,000 times more massive than the average comet. That means it is not only the largest comet discovered in modern times, but also now the largest known member of the solar system's distant Oort Cloud.

Comet Bernardinelli-Bernstein, shown in this artist's impression, is 10 times larger than most comets and 1,000 times as massive. NOIRLab/NSF/AURA/J. da Silva

The Oort Cloud is a spherical shell of icy, rocky remnants leftover from the solar system's early years. It sits beyond the Kuiper Belt, which is the region wherein Pluto orbits at an average distance of about 40 astronomical units (AU; one AU is the average Earth-Sun distance) from the Sun. The more distant Oort Cloud encompasses a region about 1,000 and 100,000 AU from the Sun. Comets within this cloud orbit the Sun at a variety of angles, rather than in the relatively flat plane of the planets, giving the Oort Cloud its spherical shape. New comets are discovered all the time, by both amateurs with constantly bigger and better telescopes, as well as by professional surveys that can scan vast swaths of the sky in a single shot. Each new comet adds to our picture of the solar system, particularly because objects in the Oort Cloud are pristine. Typically, such objects have never before approached the Sun, so when gravitational interactions toss them inward, they are discovered as comets.

Uncovering new objects to learn what they can teach us about our past is exactly why Bernardinelli and Bernstein were combing through thousands of images. These images

were taken as part of the Dark Energy Survey (DES) by the 570-megapixel Dark Energy Camera (DECam) mounted on the 4-meter Victor M. Blanco Telescope in Chile. As the name implies, the DES is designed to image 5,000 square degrees of the sky and map some 300 million galaxies to better understand the mysterious dark energy that shapes our universe. While staring into space from 2013 to 2019, DECam also spotted other objects, including numerous foreground solar system worlds interloping across the images. Within a subset of 80,000 DECam images, Bernardinelli and Bernstein identified more than 800 solar system objects passing through the shots. The comet that now bears their names appeared in 32 of those images, travelling along a trajectory perpendicular to the plane of the planets. In the earliest images from 2014, Comet Bernardinelli-Bernstein was about 29 AU (4 billion km) out, or nearly the distance of Neptune from the Sun. Astronomers estimate it actually began its journey from deep in the Oort Cloud some 40,000 AU away. That is about 15 percent the distance between the Sun and its nearest neighbor, Proxima Centauri. It is also more than 260 times farther than the farthest manmade craft, Voyager 1, currently a mere 153 AU from the Sun.



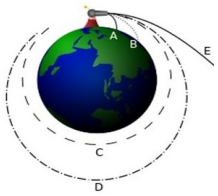
Astronomers combing through thousands of images from the Dark Energy Survey discovered the massive Comet Bernardinelli-Bernstein passing through 32 of the shots. Dark Energy Survey/DOE/FNAL/DECam/CTIO/NOIRLab/NSF/AURA/P. Bernardinelli & G. Bernstein (UPenn)/DESI Legacy Imaging Surveys. Acknowledgments: T.A. Rector (University of Alaska Anchorage/NSF's NOIRLab), M. Zamani (NSF's NOIRLab) & J. Miller (NSF's NOIRLab)

As of June 2021, Comet Bernardinelli-Bernstein had neared to 20 AU from the Sun (3 billion km), about the distance of Uranus. Based on recent images, its surface has warmed up enough to develop a coma - a cloud of dust and gas that surrounds a comet as its surface ices begin to sublimate, or turn directly from a solid to a gas. That coma officially clinches Bernardinelli-Bernstein's classification as a comet. Despite its whopping size and mass, there is nothing to worry about - Bernardinelli-Bernstein will steer far clear of Earth. When it does reach perihelion, the closest point in its orbit to the Sun, in 2031, it will still be 11 AU from our star. That is 11 times the average Earth-Sun distance, or a little farther out than the orbit of Saturn. Because it will execute its turnaround so far away, even such a massive comet probably won't grow very bright and will still require a large amateur telescope to spot. That does not mean researchers will not be eagerly following its path. Bernardinelli-Bernstein is hopefully just the first discovery in a wealth of large, icy objects flung to the far outer reaches of the solar system as the giant outer planets jockeyed for position billions of years ago. As more data from the DES are analysed and next-generation survey facilities such as the Vera C Rubin Observatory come online, further details about the solar system's violent past may soon come to light. By: Alison Klesman

What's a suborbital flight? An aerospace engineer explains 12 July: "Suborbital" is a term you will be hearing a lot as Sir Richard Branson flies aboard Virgin Galactic's VSS Unity winged spaceship and Jeff Bezos flies aboard Blue Origin's New Shepard vehicle to touch the boundary of space and experience a few minutes of weightlessness. What exactly is "suborbital"? Simply put, it means that while these vehicles will cross the ill-defined boundary of space, they will not be going fast enough to stay in space once they get there.


Virgin Galactic's Unity VSS spacecraft went on a suborbital test flight in May 2021. Virgin Galactic

If a spacecraft – or anything else, for that matter – reaches a speed of 28,000 kph or more instead of falling back to the ground, it will continuously fall around the Earth. That continuous falling is what it means to be in orbit and is how satellites and the Moon stay above Earth. Anything that launches to space, but does not have sufficient horizontal velocity to stay in space – like these rockets – comes back to Earth and therefore flies a suborbital trajectory. Although the two spacecraft launched in July 2021 will not reach orbit, the accomplishment of reaching space in private spacecraft is a major milestone in the history of humanity. Those aboard these and all future private-sector, suborbital flights will for a few minutes be in space, experience a few minutes of exhilarating weightlessness and absolutely earn their astronaut wings.



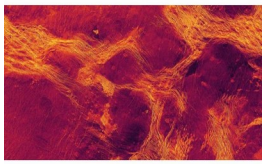
Suborbital flights (paths A and B) reach space, but are not moving fast enough over the Earth, and gravity will pull the object back to the surface. Brian Brondel, CC BY-SA

Conceptually, the flights that Branson and Bezos will be on are not terribly different from a baseball thrown into the air. The faster you can throw the baseball upward, the higher it will go and the longer it will stay in the air. If you throw the ball with a bit of sideways velocity as well, it will go farther down-range. Imagine throwing your baseball in an open field. As the ball rises, it slows down, as the kinetic energy inherent in its velocity is exchanged for potential energy in the form of increased altitude. Eventually the ball will reach its maximum height and then fall back to the ground. Now imagine that you could throw the baseball fast enough to reach a height of perhaps 97 km. Presto! The baseball has reached space. However, when the ball reaches its maximum height, it will have zero vertical velocity and start to fall back to Earth. The flight may take several minutes, and during most of that time the ball would ecperience near weightlessness – as will the newly minted astronauts aboard these spacecraft. Just like the hypothetical baseball, the astronauts will reach space but won't enter orbit, so their flights will be suborbital.

By: John M Horack The Conversation

Turns out, Venus (almost) has tectonic plates 13 July: Underneath Venus' acid clouds and crushing atmospheric pressure lies a rocky surface studded with geological mysteries. Sometimes called Earth's 'sister planet' because it is a similar size with a similar iron core, molten mantle and rocky crust, there is evidence that Venus was once a watery world, like ours, and maybe even had life (or maybe not). Now it is a 460 degree Celsius hellscape in an atmosphere choked by carbon dioxide and sulphuric acid. Scientists are really curious how it got that way, and whether it has anything to do with the fact that the volcanic plains covering most of the surface are relatively unblemished by impact craters, as if they were laid down only a few hundred million years ago. Since volcanoes are typically connected to tectonic activity, scientists are pretty keen on figuring out how the latter worked on Venus - or perhaps still works. A new look at nearly 30-year-old images

of Venus' surface from the Magellan mission has revealed that Venus' outer crust is broken up into a bunch of small, platelike pieces. They are not quite tectonic plates like we know them on Earth, but they do hint that "Venus is a lot more dynamic and a lot more interesting than we might have thought a few decades ago." says Paul Byrne, a planetary geologist at North Carolina State University. Planetary scientists are eager for new data from the upcoming VERITAS and EnVision missions to give them a better view of the planet and its geological activity.


A 1,100 km-wide, rose-colour radar view of Lavinia Planitia, one of the lowland regions on Venus where the lithosphere has fragmented into blocks (purple) delineated by belts of tectonic structures (yellow). NC State University, based upon original NASA/JPL imagery

Earth's crust is broken up into seven major and eight minor tectonic plates that are in constant motion relative to each other. The motion is driven, at least in part, by convection in the mantle. Internal heat flow in the mantle causes it to churn slowly, sort of like a lava lamp, and some of the churning motion gets transferred to the plates. The prevailing view among planetary scientists since Magellan was that Venus' crust behaves more like Mars' - rigid and immobile - than Earth's, and that it had been that way for at least the past half a billion years. However, new analyses, including Byrne's work, suggest that Venus, true to its penchant for being weird, behaves differently than either Mars or Earth (or at least it did millions of years ago).

Magellan's radar mapped 98 percent of Venus' surface between 1990 and 1992. The images show that the flat volcanic lowlands that cover over 80 percent of the planet are striped with ridges and grooves - evidence of geological pushing, pulling and scraping that must have happened sometime after the lava fields were laid down. Byrne and co-workers noticed that the ridges seemed to outline distinct chunks. They identified 58 clearly defined crust blocks in lowlands all over the planet, the largest of which is about the size of Alaska. Some of the blocks appear connected. Laurent Montesi, a planetary geologist at the University of Maryland who was not involved with the study, says he would not be surprised if there was a network of them covering the whole planet.

When tectonic plates on Earth collide, one will get shoved under the other in a process called subduction. There is no evidence of subduction on Venus, which is why it cannot truly be said to have tectonic plates. What it seems to have, Montesi says, are "rigid fragments in a sea of more mushy stuff that enables them to jostle around," pushed by the internal motion of the mantle. When they bumped into each other, the blocks crumpled at the edges to raise up the ridges that encircle them. The big question is whether Venus' crust is still moving or if it stopped millions of years ago. The answer to that question will have major implications for scientists' understanding of Venus' evolution into the strange world we now know. Was it resurfaced more or less all at once by a big volcanic cataclysm a few hundred million years ago, or did a more gradual and maybe still ongoing series of smaller events shape the planet?

It is really hard to answer questions like that without rock samples or seismic data, says Joann Stock, a structural geologist at Caltech and member of VERITAS' science team.

Unfortunately, there's no technology yet that can weather the corrosive atmosphere and surface temperatures that it would take to put a rover on Venus, so scientists have to stick with what they can gather from orbiting spacecraft. VERITAS, one of two Venus-bound missions that NASA approved this year (the other, DAVINCI+, will study the planet's atmosphere), will use state-of-the art radar to create a high-definition 3D map of Venus' surface and spectroscopy to analyze what it's made of. It's planned to launch in 2026.
Part of VERITAS' mission is to look for clues about how recent the tectonic and volcanic activity on Venus is. "We have a feeling it's really young, but we don't have numbers for that yet," says Stock. She says that the patterns Byrne and co-workers describe are "a great perspective of what we want to be looking for.

The European Space Agency's Venus Express, which analysed the planet's atmosphere from 2005 – 2014, found possible chemical hints of recent volcanic activity that scientists want to investigate further. EnVision, another European spacecraft launching in the early 2030s, will also collect high-resolution radar images and analyze Venus' atmosphere, looking for signals of active volcanism. If they are lucky, VERITAS and EnVision may see evidence that the crust blocks have shifted in the years since Magellan orbited the planet. Considering the slow march of geologic time, a few decades might not be enough time to see a difference, so "It's a shot in the dark," says Montesi, but "you miss 100 percent of the shots you don't take" so they have to at least try."It's a really weird world next door," says Byrne. "We have lots more to explore and this is going to be an exciting decade because we are going to get some answers to our questions." By: Brianna Barbu

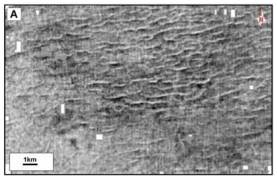
Giant ripples under Louisiana are evidence of the dinosaur-killing asteroid impact 19 July: Over 1,300 kilometres from the impact site, massive ripples buried deep underground record the devastation wrought by an asteroid. The Chicxulub impact, the likely smoking gun for the extinction of the dinosaurs at the end of the Cretaceous, sent tsunamis tearing across the Gulf of Mexico. These giant waves left ripples in the undersea sediments as they passed and a new study has found what might be the largest 'megaripples' on the planet.


Artist Impression of Chicxulub Impact. Donald E. Davis, NASA

It has been around 40 years since the Chicxulub impact, located on the northern shores of the Yucatan Peninsula, was identified as the potential cause of the famed Cretaceous-Tertiary extinction (aka., the K-T boundary). Since then, signs of this massive collision have been found across the planet. These include a layer of iridium from the asteroid, droplets of molten rock that rained down after the impact, wave deposits as far away aas North Dakota and the charred remains of forest burned by the heat of the blast.


The Cretaceous-Tertiary boundary (marked) from southern Alberta in Canada. Mike Beauregard, Flickr

We are still discovering the results of that bleak day 66 million years ago. A new study by Gary Kinsland and others might have revealed the deposits left by the massive tsunamis created by the impact. When the asteroid, thought to have been 10 km across, blasted into the shallow proto-Gulf of Mexico, it unleashed waves that raced across the sea. At that time, the coastline along the north of the gulf was much further north thanks to high sea levels, so the modern state of Louisiana was under a hundred or so feet of sea water. The tsunamis that sloshed across the gulf carried sediment and deposited it in the form of massive ripples across what is now dry land in central Louisiana.



Seismic image of the buried megaripples in central Louisiana. Kinsland and others, EPSL (2021)

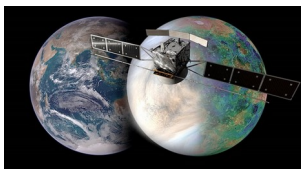
These megaripples are the first to be identified from the Chicxulub impact. Now, these ripples are, on one hand, much like you might see on a beach. On the other hand, they were huge. The average height of the ripples is 15 metres and their wavelength is almost a kilometre. The megaripples were so well preserved because the sea was deep enough that later storms did not disturb the features. The megaripples are not visible at the Earth's surface today. They' hae been buried by later sediments but they show up in seismic data that has been collected over the decades by petroleum companies. Seismic data like these show changes in the layers of rock and sediment based on their characteristics like composition and density by using how the speed of seismic waves change as they pass by. Think of it somewhat like sonar for underground. There is a vast trove of geophysical data about our planet locked away in proprietary data sets like these (and one can hope it can see the light of day when we move away from fossil fuels). Until then, these Louisiana megaripples are a tantalising clue into what it might have been like for days after the Chicxulub impact, where massive tsunamis rolls back and forth across the Gulf of Mexico. By: Erik Klemetti

Venusian trio: ESA teams up with NASA to send another spacecraft to Venus 20 July: Venus may be Earth's sister, but it certainly is not our twin. Where Earth is the perfect goldilocks planet, Venus' evolution took it down a more toxic path. Scientists still do not exactly know why our planetary neighbour experienced a dramatic climate shift in its past, despite both worlds being roughly the same size and composition. From above, the European Space Agency (ESA) is hoping to get to the bottom of Venus' mysterious past with the help of their planned orbiter: EnVision. Selected by ESA's Science Programme Committee, EnVision is part of the agency's Cosmic Vision plan, their current planning cycle for its space science missions.


EnVision orbits Venus in this artist's concept. ESA/VR2Planets/Damia Bouic

EnVision will be equipped a suite of instruments ranging from a sounder to reveal underground layering, a NASA-provided radar to map Venus' surface, a radio science experiment to probe the planet's internal structure and gravity field, and spectrometers to

study the oppressive Venusian atmosphere. The ESA currently plans to launch EnVision in the early 2030s.


NASA / JAXA / ISAS / DARTS / Damia Bouic / VR2Planets

ESA's orbiter will not be the only new spacecraft exploring the planet. Two NASA missions - DAVINCI+ (Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging) and VERITAS (Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy) - are also headed for Venus around the same time. "EnVision leverages strengths in instrument development by both our agencies," said Thomas Zurbuchen, NASA's associate administrator for science. "Combined with NASA's Discovery missions to Venus, the science community will have a powerful and synergistic set of new data to understand how Venus formed and how the surface and atmosphere changed over time."

Before EnVision comes close to Venus, however, there are a few more steps. Now that it has been selected, EnVision moves on to the more detailed 'Definition Phase', during which the design of both the satellite and its future instruments is finalised. Then it is down to an industrial contractor to build and test EnVision before a final launch date is set. After launch, it is just a measly 15-month trip to our sister planet. "A new era in the exploration of our closest, yet wildly different, solar system neighbour awaits us," said Günther Hasinger, ESA Director of Science. By: Caitlyn Buonogiorno

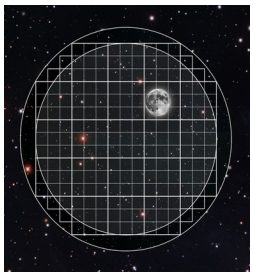
A deluge of blinking lights is changing how astronomers work 29 July: In the year 1054, a new star appeared in the constellation Taurus. The faint speck of light brightened rapidly, soon outshining other imposing stars in the northern sky. In a matter of days, the star's brightness peaked. It stayed visible for weeks, even during the day, before it started to dim and slowly fade into nothingness. The baffling star that embellished the sky in 1054 was in fact a supernova, just one of many transient sources appearing in the sky - that is, objects related to events that occur on short timescales, often changing visibly from night to night. Taking many forms and colours, some transients originate in the Milky Way, while others are objects exploding in galaxies far away. The interest in transients has never been greater. Many surveys of the sky are discovering new sources at unprecedented rates. In 2019, astronomers reported about 20,000 newly discovered transient objects at visible wavelengths, about 100 times greater than a decade prior to that.


The bright supernova SN 2018gv explodes in the spiral galaxy NGC 2525 in this Hubble Space Telescope image. NASA, ESA, A. Riess and the SH0ES team

This firehose of data has the potential to transform astronomy and provide insight into subjects ranging from dark energy and dark matter to the evolution of our solar system. However, it also presents unique challenges - how to make sense of the data, and how to follow up on it. Surveys find transients by imaging the same parts of the sky with a certain cadence. A sequence of images reveals new sources and their change in brightness over

time. Such information is not always enough to classify a transient. For that, one would need to obtain a spectrum of the transient, and perhaps even observe it at infrared, X-rays, or radio wavelengths. However, the era when astronomers could follow up on every object that came along has already gone away - there are now simply too many being found. "We're already for many years in a regime when you have to make choices [about] what you classify spectroscopically and what you don't, and that depends on science," says Daniel Perley, a researcher at Liverpool John Moores University in the UK. It is telling that the community obtained the spectra for only about 10 percent of transients discovered in 2019.

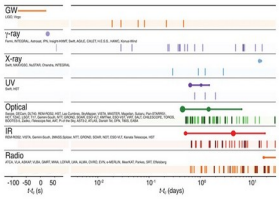
Perley's goal is to take stock of the bright transient population detected by the Zwicky Transient Facility (ZTF), which has been one of the most productive transient surveys since it began operating in 2018, spotting supernovae and fast-moving asteroids alike. By limiting the study to the brightest sources, it is feasible to take useful spectra of every object in the survey and learn, for example, how many supernovae of a certain spectral type explode in the universe. Scientists interested in particular types of transients, like those exhibiting an especially red or blue colour, have to take a different approach. For them, the initial limited amount of information determines whether a transient merits a long follow-up observation campaign. Their decision to use additional resources on a transient is based on experience, yet it always carries a bit of risk - you do not really know a transient until you take that additional observation.


Some transients emit light at different wavelengths. This timeline shows the observations of the neutron star merger GW170817. The merger emitted gravitational waves, followed by light spanning the electromagnetic spectrum. Rubin Obs/NSF/AURA

That experience from ZTF and other transient facilities will come in handy once the Vera C rubin Observatory in Chile comes online in a few years. "The Rubin Observatory is going to increase the discovery rate by two orders of magnitude, from 10,000 per year to a million new supernovae and transients per year," says Ashley Villar, an assistant professor at the Pennsylvania State University. "This is a breaking point for our field." The flood of transients discovered by the Rubin Observatory will include specimens that current surveys rarely find, such as very distant supernovae or very faint supernovae exploding in nearby galaxies. Scientists expect that the observatory will also discover completely new types of transients. According to expectations, less than 0.1 percent of all transients discovered by the Rubin Observatory will get extra attention. Developing reliable techniques to recognise interesting transients in the clutter is therefore of paramount importance.

Villar plans to use a neural network, a type of machine learning, to search the data for anomalous transients with unanticipated properties. However, she expects researchers will employ a wide variety of strategies to work with such massive datasets. "Some people will lean towards totally automated queue systems that just rank targets, look at their observability, and make some intelligent choice," says Villar. "Others will want to have

humans in the loops, looking at the data, asking simple questions, and deciding from there."



Some transients emit light at different wavelengths. This timeline shows the observations of the neutron star merger GW170817. The merger emitted gravitational waves, followed by light spanning the electromagnetic spectrum Abbott et al. (2017)

Some kinds of transients stand out based on the wavelengths of radiation they they emit - which can range from gamma rays to radio waves - and how their brightness changes over time. That means that searches tailored towards these particular kinds of transients can avoid the classification and follow-up problems encountered in searches at optical wavelengths. For instance, fast radio bursts - immensely powerful blasts of radio waves possibly caused by flaring magnetars - is immediately distinguishable. "You can already tell from the first discovery that it's a fast radio burst, approximately how far away it's coming from, and its energetics," says Emily Petroff, a radio astronomer at the University of Amsterdam.

While the transient field is flourishing, a threat looms on the horizon: the rise of light pollution across the electromagnetic spectrum. For instance, radio telescopes searching for transients are sensitive to emissions from phones, cars, airplanes, and various kinds of satellites. The problem is getting worse. "We're constantly playing the game of cat and mouse with new sources of interference that we're finding at our telescope sites," says Petroff. So far, optical astronomers have been able to escape the pollution by observing from remote and dark oases. However, the recent upsurge in bright commercial satellites - like SpaceX's Starlink constellation - is already disturbing observations. The anticipated fleet of satellites, which numbers in the tens of thousands, profoundly worries the community. The Rubin Observatory, in particular, has been developing a multi-pronged approach to mitigate its impact, working with SpaceX to reduce the reflectivity of its satellites and also developing algorithms to remove satellite trails from images.

Despite these challenges, researchers persist. It is easy enough to point a telescope at the sky. However, to make sense of all the blinking lights, both cosmic and artificial, astronomers are adapting and developing clever techniques. It is worth it, because one of those lights could turn out to be something unlike anything we have seen before.

By: Jure Japelj

International Space Station saved from out-of-control spin 30 July: The International Space Station (ISS) spun out of control on Thursday when a Russian module unexpectedly began firing its rocket thrusters, sending flight controllers in Moscow and Houston scrambling to recover the station. The incident was one of the most serious in the space station's 22-year history, resulting in a 47-minute period where the station was deemed to be experiencing a "loss of attitude control" as other thrusters fired off in an effort to stabilise the orbiting outpost.

In a media teleconference on Thursday afternoon, Kathy Lueders, head of NASA's human spaceflight program, called it "a pretty exciting hour", and credited the mission team's

preparedness and contingency planning with regaining control of the station. “Never have I ever been prouder of the team,” tweeted ISS Flight Director Zebulon Scoville, who was one of two flight directors overseeing Mission Control during the incident. He added that he’d also never “been so happy to see all solar arrays [and] radiators still attached.” In a statement released on Friday, the Russian space agency Roscosmos said the errant firing was a result of a computer glitch. “Due to a short-term software failure, a direct command was mistakenly implemented to turn on the module's engines for withdrawal, which led to some modification of the orientation of the complex as a whole.”


The Russian laboratory module Nauka docked with the International Space Station on Thursday, seen here in a photograph taken by crew aboard the station. NASA/Shane Kimbrough

The module, a laboratory named Nauka, had docked with the station on Thursday morning. Roughly three hours later, as the crew prepared to open the module’s hatch, the station’s attitude (or orientation) began drifting. The astronauts reported that they could see Nauka's thrusters firing. Mission Control declared a loss of attitude control. Control authority of the station was then handed off to the Mission Control Centre in Moscow, which called the station’s Russian-built Service Module into action, firing its thrusters to counteract the stuck thruster on Nauka. However, Nauka’s position, sticking out from its docking port outside the station, gave it more leverage than the Service Module could handle. “The ISS brought a knife to a gun fight,” as Scoville put it. This prompted controllers to call upon a Progress module that was docked at another port to fire its thrusters, bringing “more ‘muscle’ and moment arm to the force fight,” Scoville tweeted. Eventually, the Nauka thruster exhausted its propellant, and attitude control was restored.

Initial reports from flight controllers suggested that the station had drifted from its stable orientation by 45 degrees. Hoever, Scoville said the amount of pitch was actually much greater. “Got about as far out of attitude as you can,” he said on Twitter. “We proceeded to do headstands and cartwheels,” he added. “Olympic judges would be proud.”


The International Space Station weighs approximately 420 metric tons (925,000 pounds). NASA

A stuck thruster can quickly cause a spacecraft to roll and tumble with dangerous or even disastrous consequences. Since there is no air resistance in space, there is nothing to slow its rotation, and a stuck thruster can accelerate a craft’s rate of spin to no end. In 1966, astronauts Neil Armstrong and David Scott found themselves in one such life-threatening scenario during the Gemini 8 mission. A stuck thruster sent their capsule into an end-over-end tumble and roll, reaching a rotation rate of 300 degrees per second. Scott thought they were in danger of passing out. The crew were only able to wrestle the craft back into a stable attitude by activating the craft’s Re-entry Control System, effectively aborting the mission.

Thanks to the efforts of the thrusters on the ISS Service Module and Progress - and because the ISS has a much greater mass and moment of inertia than the Gemini capsule - the station did not reach anywhere near that rate. It peaked at about half a degree per second, which would have seen it do a 360-degree spin in 12 minutes. However, for a facility as massive as the ISS, it was a harrowing incident. "The crew was never and is not in any danger," NASA said, though Scoville offered a more nuanced take: "When NASA says crew was never in danger that ignores [the] obvious truth that they are living on an experimental SPACE STATION and in danger as soon as rocket engines light on the pad. Today had a little more danger than your typical orbit punching Thursday."

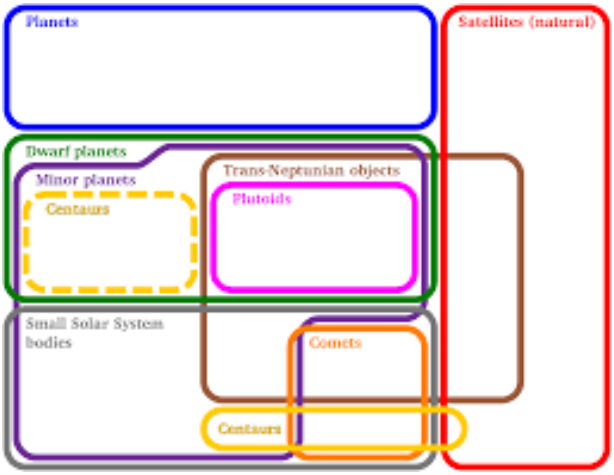
By: Mark Zastrow

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

DID YOU KNOW?

Solar system objects Part 1: Overview (1)

The current classification of the objects in the solar system is based on resolutions made by the International Astronomical Union, particularity at their 2006 meeting. Groups have discrete definitions, but there is much overlap. Some objects can be of more than one type eg a dwarf planet and an asteroid, a moon and a trans-Neptunian object or a dwarf planet and a minor planet.



This Euler diagram is a useful means of representing the complex relationships and overlaps among the groupings currently accepted for the objects present in the solar system. While it illustrates relationships, the relative sizes of boxes is not an indication of the actual number of astronomical objects included within each box.

Planets

The name 'planet' comes from the Ancient Greek word for 'wanderer' or 'wandering star'. Earth was believed to be stationary at the centre of the Universe while objects in the sky revolved round it. The name refers to the lights which moved across the sky more often and more dramatically than other bright objects (stars).

In 2006, the following three conditions were agreed by the International Astronomical Union for an object in the solar system to be called a planet. It must:

- be in orbit around the Sun
- be massive enough to be rounded by its own gravity
- have cleared its neighbourhood region of planetessimals (small objects from 0.1 – 100 km in diameter)

These conditions were. and continue to be, controversial, as they exclude a number of planetary-mass objects previously considered to be planets, based on where or what they orbit eg Pluto.

There are, thus, at present, eight planets in the solar system: four inner small, rocky terrestrials (Mercury, Venus, Earth, Mars) and four large low-density gas (Jupiter, Saturn) and ice (Uranus, Neptune) giants. Six are themselves orbited by one or more natural satellites (moons). Mercury and Venus are the exceptions.

Sources: Ridpath, I (Ed) 2012 Oxford dictionary of astronomy 2nd rev ed,, Slotegraaf, A and Glass, I (Eds) 2020 Sky guide: Africa south, britannica.com, en.wikipedia.org, space.com

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

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