"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

OCTOBER 2021

Monthly meeting This months **Zoom meeting** will take place on the evening of **Monday 18 October,** starting at **18.30.** Access details will be circulated to members closer to the time. The presenter is **Dr Petri Väisänen**, Director of the SAAO in Cape Town. Details of his talk will be circulated, in due course.

Membership renewal for 2022
There will be no increase in fees next year.

The 2022 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 remaining dates of the monthly meetings for 2021 are as follows: 18 October and 15 November.

WHAT'S UP?

Scorpius Eponymous S-shaped Scorpius makes it an easy constellation to find. Considered a winter constellation in the southern hemisphere, it continues to be visible towards the West as the seasons change. Throughout October, after sunset, Venus can be seen moving against the distinctive shape of the scorpion. In Greek mythology, it represents the scorpion which stung Orion to death. Its presence in the skies when Orion is absent supports the legend that Orion is being chased away by the Scorpion. It used to be a much larger constellation as it included what is now another of the zodiacal constellations, Libra. In ancient Greece, the two bright stars of Libra were taken to mark the tips of the scorpion's claws. Today, Libra represents the scales of justice held by Virgo, its neighbour to the left. The 'heart' of the scorpion is marked by the red supergiant Antares. Located around 554 ly away, its diameter is 400x that of the Sun, and it is 10,000 times brighter. The Greek name 'Antares' translates as 'rival of Mars' because its strong red colour competes with that of Mars.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the Zoom meeting on 20 September Case Rijsdijk, Gill medallist (ASSA) and chairman of the Garden Route Centre gave a very interesting and thought-provoking presentation on 'The very early universe'. From his scientific perspective as a physicist, Case said that he liked to look at the history of the universe backwards in time, from the present to as far as telescopes and other observational equipment can see, rather than the forward timeline from the Big Bang commonly presented. Using the energies involved in the different stages of the Big Bang / cosmic inflation as reference points, he outlined their characteristics and the nature of particles and matter at each stage. His focus on what occurred before the time of the cosmic microwave background identified that the further back in time scientists go, the more science moves into the quantum world. Questions which Case raised and which remain to be observed and studied scientifically include what happened to anti-matter?, are quarks formed of even smaller particles? and, if so, what are these particles? Case concluded by noting the existing and planned telescopes eg SKA which are and will continue to enable astrophysicists and cosmologists to look back ever further in time to increase their knowledge and understanding of the very early universe.

Interest groups

Cosmology At the Zoom meeting, held on 6 September, Derek Duckitt presented two videos by the astrophysicist Andrei Linde, one on 'Chaotic inflation', the other on 'The multiverse'.

Astro-photography The 13 September meeting was cancelled.

Other activities

Educational outreach No activities took place during September.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's **Zoom meeting**, will take place on the evening of **Monday 18 October** starting at **18.30**. Access details will be circulated to members. The presenter is **Dr Petri Väisänen**, Director, SAAO, Cape Town. Details of his presentation will be circulated, in due course.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month. The next meeting, on the evening of **Monday 4 October** 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. The next Zoom meting will take place on **Monday 11 October**.

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** Whilie no events will take place during the coronavirus pandemic, members are encouraged to submit their own images for circulation to the membership. Please send them to Peter Havey at 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: 20 September, 18 October and 15 November.

The remaining external speaker is Petri Vaisänen (October) and the remaining Centre member presenter is 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

Why have humans not reached Mars? 8 September: When it comes to interplanetary destinations in our solar system beyond Earth, there are not a lot of great options when it comes to weather, conditions, or even simply solid ground. Our near neighbour Venus is so hot we would burn up before getting anywhere near solid ground. Pluto and breaks the thermometer in the opposite direction with temperatures as cold as -240 degrees Celsius. Meanwhile, Neptune, Uranus, Saturn, and Jupiter are mostly made up of toxic gases that would kill us even if they did have solid ground to walk on, and that is without even mentioning the storms. Mars is really the only planet that sits within the habitable orbit around our Sun. After more than a half century, humans have walked on the moon and delivered spacecraft that has flown to Pluto and even left the edges of our solar system. We have even landed several spacecraft on Mars, including the NASA Perseverance rover and China's Zhurong rover currently moving around the planet and beaming back photos and other valuable information as we speak. So why have humans not yet travelled to Mars?

 Gorodenkoff/Shutterstock

According to NASA, there are a number of obstacles that we still need to overcome before sending a human mission to the planet, including technological innovation and a better understanding of the human body, mind and how we might adapt to life on another planet. In short, these obstacles can be summarised into four major problems, say Michelle Rucker, lead of NASA's Human Mars Architecture Team at NASA's Johnson Space Center and Jeffrey Sheehy, chief engineer of the NASA Space Technology Mission Directorate: Get there, land there, live there and leave there.

"The first obstacle is just the sheer distance," Rucker says. The Red Planet is about 55 million kilometres away at its closest point. However, the distance to Mars is nt always the same. The Earth and Mars orbit the sun at different distances and speeds, meaning that there are certain more optimal periods to travel between the two, especially considering the idea is to not just to make it to Mars quickly, but to make it back. "The trains to Mars are every 26 months," Sheehy says, adding that the last such window occurred in July 2020. That last train was perhaps the busiest period ever seen for interplanetary travel - three uncrewed Mars missions were launched last summer in the space of two weeks. All 26-month windows are not the same, though. Sheehy notes that on top of this, there is a larger roughly 15-year cycle when that window is even more favourable than others. However, Sheehy adds that a vehicle optimised to reach the planet during the most favourable opportunity may not be necessarily the same we would need for other years. Focusing all our efforts on reaching Mars in that window would mean we would only have a chance every 15 years - it would be something of a "one-trick pony" in other words.

Technology of course plays a role in all of this. Most rockets that we have launched out of the atmosphere have been propelled by rocket fuel. However, this fuel for an all-chemical propulsion system would take a lot of space, and would not be optimal for the longest travel times. To reach Mars quicker and more often a system based on nuclear thermal propulsion or nuclear electric propulsion would be more effective - and that is if we set our sights low in terms of ship size, Sheehy says. His organization is working on seeraldifferent nuclear fission technologies, including a fission surface power system. They plan to demonstrate one on the moon.

Aside from technology, we also need to learn more about how humans - creatures that evolved to live in the Earth's atmosphere with the Earth's gravity - are going to cope with being in a low gravity, close proximity, close environment situation on spaceships for several months of transit. Work on this has been underway for some time, whether it is studying how astronauts living on the International Space Station cope with the isolation and low gravity up there, and how they cope when coming back to Earth. The various lunar missions have also revealed how the astronauts there dealt with the low-gravity situation there Furthermore, missions like BNASA's CHAPEA, a planned yearlong Mars simulation, will also informing scientists about what kind of problems might arise with a small group of people over a long mission. Other ongoing research missions in Antarctica can also help inform us what to expect. These kinds of questions are important for determining how long it takes, and how many people are needed, to pull off basic tasks.

Another concern is how humans may be able to manage living in small confined spaces for a long time without much outside contact. "If you are tired of the food you're eating you can't say 'Let's order a pizza,'" Rucker says. Another tool to help us learn how to cope with unexpected challenges will be the Artemis mission, which is working to keep a sustainable population on the moon. Many of the technologies for day to day living on the moon, as well as how living conditions might affect the people there, will help to inform a future Mars mission.

Getting to Mars' orbit is only half the battle. The other challenge is landing on the Red Planet safely, though not necessarily in one piece. Sheehy says that NASA is working on developing an inflatable deceleartor - something like a reverse parachute that would protect and slow the landing craft while penetrating the atmosphere. To actually land, the craft would need something like supersonic retropulsion - basically jets on the bottom that reverse the massive thrust enough to bring the craft safely to the ground. To overcome the challenge of developing this, Sheehy says that NASA plans to launch such a system into our orbit then land it back on Earth to see if it works.

Once on the ground, another potential obstacle is the dust storms. Dust proved to be a major irritant to astronauts on the moon. Since no wind or other forces erode the particles, the dust was sharp and chafing on parts of astronauts' suits. It got everywhere, and irritated the eyes. Mars dust may not be quite so sharp since there are erosive forces there, but the dust storms can be massive - in 2018 the rover Opportunity went offline after one bad tempest there. Rucker says that researchers have learned a lot about these Martian dust storms, but they are still not quite sure if they have witnessed the worst of them. Aside from the risk to any astronauts or equipment on the planet, the storms also kick up enough dust to block sunlight, meaning any solar-powered equipment may not work well for a period. Equipment is a serious concern while on the planet as well. Sheehy says that any human mission to Mars would likely need to be preceded by a cargo delivery. "Those things would be put there and checked out before we even commit to sending astronauts," he says.

Other obstacles to overcome would be the building of the ship to travel there. Sheehy and Rucker estimate it would at least need to be the size of a football field in length, depending on the propulsion system technology we go with and how many people we ultimately decide to send. Roughly anything from a little smaller than the International Space Station in size to significantly bigger. Both believe that we may get there in the 2030s. The next most favourable window for sending humans on a relatively quick round-trip to Mars would be in 2033, but it is unclear whether politics, budget and technology will be ready by then. Until then, we're learning more every day. "We are laying a lot of the ground work for going to Mars," Rucker says. By: Joshua Rapp Learn

Perseverance samples its first (two) rocks 9 September: NASA's newest rover is on a mission to not only explore Mars but collect samples for future study on Earth. Perseverance is carrying 43 sample tubes, inside which it will store drilled samples of rock for later collection. The first step in this process, naturally, is storing each sample in a tube. On 6 August, NASA announced that the rover's first collection attempt had turned up empty. The autonomous sample collection process saw the rover successfully drill into the rock and place the result into a tube. However, a subsequent step - using a probe to measure the volume of the sample in the tube - indicated nothing was inside. "The probe did not encounter the expected resistance that would be there if a sample were inside the tube," said Perseverance's surface mission manager, Jessica Samuels of NASA's Jet Propulsion Laboratory (JPL)


Perseverance rolls up to its second sample attempt. NASA/JPL-Caltech

Mission controllers were confident the rover's drill and coring bit had operated properly. So, they concluded, it was the rock that had misbehaved. Called Roubion, this first target is what researchers call a paver stone - flat, polygonal rocks they believe are some of the oldest in the crater. Such rocks are so old and weathered that their crumbly texture thwarted sampling attempts. To find a better target, controllers drove to a ridge called Citadelle, with outcroppings of rocks very different from the paver stones. On 2 September, Perseverance successfully completed its first sample collection. This time, images from the rover showed the rock core, a bit wider than a pencil, snug in its sample tube.

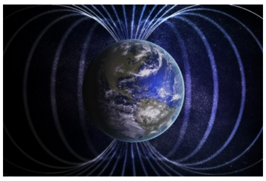

The borehole from Perseverance's first sample attempt shows the target rock's poor integrity. NASA/JPL-Caltech/MSSS

The team still hopes to revisit sampling a paver stone in the future. Next time, though, they willl likely target a different, less weathered type of paver in the hopes that such rocks will provide similar information - from inside a sample tube this time.

By: Alison Klesman\

When north goes south: Is Earth's magnetic field flipping? 14 September: Something odd is happening to Earth's magnetic field. Over the last 200 years, it has been slowly weakening and shifting its magnetic north pole (where a compass points, not to be confused with the geographic north pole) from the Canadian Arctic toward Siberia. In recent decades, however, that slow shift south has quickened - reaching speeds upwards of 48 kilometres per year. Could we be on the brink of a geomagnetic reversal, in which the magnetic north and south poles swap places?

Earth's magnetic field is generated by the convection of molten iron in the planet's core, around 1,896 km beneath our feet. This superheated liquid generates electric currents that in turn produce electromagnetic fields. While the processes that drive pole reversal are comparatively less understood, computer simulations of planetary dynamics show that the reversals arise spontaneously. This is supported by observation of the Sun's magnetic field, which reverses approximately every 11 years. Our own magnetic field came into existence at least 4 billion years ago, and Earth's magnetic poles have reversed many times since then. Over the last 2.6 million years alone, the magnetic field switched ten times - and, because the most recent occurred a whopping 780,000 years ago, some scientists believe we are overdue for another. However, reversals are not predictable and are certainly not periodic.


vchal/Shutterstock

Researchers map out the ancient history of Earth's magnetic field using volcanic rocks. When lava cools, the iron that it contains is magnetized in the direction of the magnetic field. By examining these rocks and using radiometric dating techniques, it's possible to reconstruct the past behaviour of the planet's magnetism as it strengthened, weakened or changed polarity. To track more recent magnetic changes, scientists turn to the magnetic properties of archaeological artefacts. When our ancestors heated an ancient hearth or kiln containing iron to high enough temperatures, it would realign its magnetism with Earth's magnetic field upon cooling. The point at which this occurs is known as the Curie point. Studies have even included some floor segments of an Iron Age building in Jerusalem, which a Babylonian army burnt down in 586 BCE.

Carrying out measurements on these archaeological artefacts is difficult. For one, the magnetism in ancient objects is very weak - not enough to move a compass needle. Also, if any objects were heated and cooled several times, several magnetic patterns will be superimposed. Lastly, their reliability is dependent on the objects remaining in the same location that the heating took place. Despite these difficulties, researchers have largely mapped modern changes in the magnetic field beneath western Europe and the Middle East.

Scientists cannot be sure of the exact repercussions that a reversal will have - the evidence from previous reversals remains unclear - but they may be serious. For instance, many animals use the Earth's magnetic field for navigation during migration. Juvenile loggerhead turtles dig their way out of underground nests on the beaches of Florida, enter the sea and travel far into the Atlantic Ocean (sometimes completely traversing it). Then, after many years, they return to the same Florida beaches on which they were born. They navigate this featureless, 14,494-km journey by detecting the strength and direction of the magnetic field. When it comes to the salmon, whales, birds and other creatures that also use Earth's magnetism to navigate, their lives would be seriously disrupted by a reversal of the magnetic field. Additionally, Earth is constantly bombarded with a stream of charged particles arriving from the Sun and cosmic rays, mostly protons and atomic nuclei, from deep space. In the period leading up to a reversal, the magnetic field becomes weaker and significantly less effective at shielding us from those particles. While some geologists note that mass extinctions seem to correlate with these time periods, humans or our ancestors have been on Earth for several million years. During that time there have been many reversals, and there is no obvious correlation with human development.

The direct effect on mankind could be only slight, but not so for technology. We use artificial satellites for navigation, television broadcasting, weather forecasting, environmental monitoring and communication of all kinds. Without the protection of a magnetic field, these satellites could be seriously disrupted by solar wind or cosmic rays colliding with electronic circuits. A weak magnetic field in the South Atlantic Ocean, known as the ‘south Atlantic Anomaly’, already adversely affects satellites and could be an indication of what is to come. Recent geological studies have suggested a possible reason for the anomaly. It is widely believed that our Moon was formed when Earth was struck by the planet Theia 4.5 billion years ago, but the remains of Theia have never been found. It now appears that the remains of Theia may lie beneath our feet. There are two huge volumes of rock buried deep in the Earth, each one millions of times larger than Mount Everest (and expanding) and denser and hotter than the rest of Earth’s mantle. Scientists suggest that these rock masses are the missing remains of Theia and that they interfere with the convection of molten iron - giving rise to the weak magnetic field in the South Atlantic.

Regardless, the seriousness of a magnetic reversal will depend on how long the reversal takes to complete. If it slowly shifts for many thousands of years, it is possible that migratory creatures, and mankind as well, will be able to adapt. In the meantime, we have much to learn about what is happening deep within our planet. By: Chris Holt

How many satellites are orbiting Earth? 22 September: It seems like every week, another rocket is launched into space carrying rvers to Mars, tourists or, most commonly, satellites. The idea that “space is getting crowded” has been around for a few years now, but just how crowded is it? Also, how crowded is it going to get?


Thousands of the satellites orbiting Earth are small – like this cubical satellite seen here being released from the International Space Station. NASA, CC BY-NC

I am a professor of physics and director of the Centre for Sapce Science and Technology at the University of Massachusetts, Lowell. Many satellites that were put into orbit have gone dead and burned up in the atmosphere, but thousands remain. Groups that track satellite launches do not always report the same exact numbers, but the overall trend is clear – and astounding. Since the Soviet Union launched Sputnik – the first human-made satellite – in 1957, humanity has steadily been putting more and more objects into orbit every year. Over the second half of the 20th century, there was a slow but steady growth, with roughly 60 – 100 staellites launched yearly until the early 2010s. Since then, the pace has been increasing dramatically. By 2020, 114 launches carried around 1,300 satellites to space, surpassing the 1,000 new satellites per year mark for the first time. But no year in the past compares to 2021. As of 16 September, roughly 1,400 new satellites have already begun circling the Earth, and that will only increase as the year goes on. Just this week, SpaceX deployed another 51 Starlink satellites into orbit.


The ever-shrinking size of technology has led to tiny satellites like the one students are working on here. Edwin Aguirre/University of Massachusetts Lowell, CC BY-ND

There are two main reasons for this exponential growth. First, it has never been easier to get a satellite into space. For example, on 29 August 2021, a SpaceX rocket carried several satellites – including one built by my students - to the International Space Station.

On 11 October 2021, these satellites will deploy into orbit, and the number of satellites will increase again. The second reason is that rockets can carry more satellites more easily – and cheaply – than ever before. This increase is not due to rockets becoming more powerful. Rather, satellites have become smaller, thanks to the electronics revolution. The vast majority – 94% – of all spacecraft launched in 2020 were smallsats – satellites that weigh much less than around 600 kilograms.

The majority of these satellites are used for observing Earth or for communications and internet. With a goal of bringing the internet to under-served areas of the globe, two private companies, Starlink by SapceX and oneWeb together launched almost 1,000 smallsats in 2020 alone. They are each planning to launch more than 40,000 satellites in the coming years to create what are called 'mega-constellations' in low-Earth orbit. Several other companies are eyeing the US$1 trillion market, most notably Amazon with its Project Kuiper.

Large satellite constellations – like SpaceX's Starlink– are set to dramatically increase the number of objects orbiting Earth and are already causing problems. With the huge growth in satellites, fears of a crowded sky are starting to come true. A day after SpaceX launched its first 60 Starlink satellites, astronomers began to see them blocking out the stars. While the impact on visible astronomy is easy to understand, radio astronomers fear they may lost 70% sensitivity in certain frequencies due to interference from satellite mega-constellations like Starlink. Experts have been studying and discussing the potential problems posed by these constellations and ways the satellite companies could address them. These include reducing the number and brightness of satellites, sharing their location and supporting better image-processing software. As low-Earth orbit gets crowded, concern about space debris also increases, as does a real possibility of collisions.

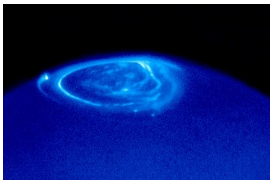
Less than 10 years ago, the democratisation of space was a goal yet to be realised. Now, with student projects on the Space Station and more than 105 countries having at least one satellite in space, one could argue that that goal is within reach. Every disruptive technological advancement requires updates to the rules – or the creation of new ones. SpaceX has tested ways to lower the impact of Starlink constellations, and Amazon has disclosed plans to de-orbit their satellites with 255 days after mission completion. These and other actions by different stakeholders make me hopeful that commerce, science and human endeavours will find sustainable solutions to this potential crisis.

By: Supriya Chakrabarti, The Conversation

Jupiter's aurorae trigger heat waves 22 September: For 50 years, researchers have struggled to explain one of Jupiter's enduring mysteries: Why is its upper atmosphere so hot? Based on the intensity of sunlight Jupiter receives, its highest reaches should be a brisk−73 degrees Celsius. Instead, they sizzle at about 426 degrees C. One hypothesis held that Jupiter somehow generates heat from below - perhaps from storms lower in its atmosphere. Or, some speculated, its innards could still be gravitationally settling and releasing heat. However, the main suspect has been Jupiter's aurorae, which are produced when the planet's magnetic field traps charged particles and funnels them to its poles. When those particles smash into atmospheric molecules, they cause them to glow - and inject a tremendous amount of energy at the poles in the process.

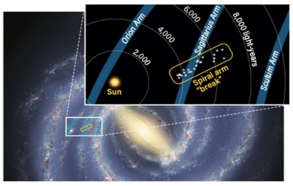

Waves of heat emanate from Jupiter's aurorae, distributing energy from the poles toward the planet's equator, in this illustration of an infrared view. J. O'Donoghue (JAXA)/Hubble/NASA/ESA/A. Simon/J. Schmidt

While in principle, this could heat the entire planet, atmospheric models have predicted that the planet's strong winds trap heat at the poles and prevent it from spreading to lower latitudes. However, a study suggests those models may be missing something. An international team of researchers used the Keck Observatory in Hawaii to measure infrared emission from hydrogen molecules in Jupiter's atmosphere, producing a high-resolution temperature map of the planet. Their analysis revealed that the polar regions directly under the aurorae were some 400 degrees C hotter than equatorial climes, clear evidence of the aurora's ability to heat the poles. On the team's second night of observations (25 January 2017, roughly nine months after their first), they also found evidence that this heat can spread elsewhere: A hot band appeared south of the main auroral oval, 200 degrees C warmer than its surroundings and wrapping halfway around the planet.


Jupiter's aurorae dance above Jupiter's polar region in this Hubble Space Telescope image taken in 1998. Unlike Earth's aurorae, the charged particles that produce the aurorae at Jupiter come mostly not from the solar wind but from volcanoes on Jupiter's moon Io. NASA, ESA & John T. Clarke (Univ. of Michigan)

Auroral heat wave? The team argues this is a wave of heat travelling from the poles toward the equator. Strengthening their case, they note that the wave occurred at a time when the solar wind was predicted to be relatively strong at Jupiter, which would have triggered more intense auroral heating. **"**It was pure luck that we captured this potential heat-shedding event," said James O'Donoghue, a planetary scientist at the JAXA Institute of Space and Astronautical Science in Sagamihara, Japan, and the study's lead author, "If we'd observed Jupiter on a different night, when the solar wind pressure had not recently been high, we would have missed it!" The team thinks this event shows the aurorae are likely responsible for most of Jupiter's excess heat - though exactly how Jupiter's atmosphere manages to circulate that heat remains unclear.   By: Mark Zastrow

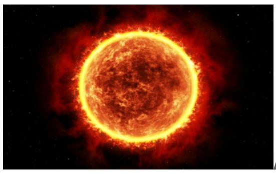
The Milky Way diagnosed with a broken arm 29 September: Even though we call it home, the Milky Way remains rich with mysteries and surprises. Case in point: Astronomers recently noticed our galaxy has a broken arm. Stretching about 3,000 light-years long, this splinter of stars and gas juts out from the Sagittarius Arm at a roughly 45° angle. While it is not unusual to spot sharply-angled spurs (also called feathers) in other spiral galaxies, it is the first time that astronomers have noticed a defect this stark in our own galaxy's arms.



No cast required. A collection of stars and gas clouds jut awkwardly from the Milky Way's Sagittarius Arm in this artist's concept. The distance and size of the break is shown in the inset. NASA/JPL-Caltech

From Earth's position within the Milky Way, it is difficult for scientists to see the entirety of the galaxy. Astronomers used data obtained by the now-retired NASA Spitzer Space Telescope and by the European Space Agency's Gaia mapping mission to confirm they were seeing a section of the Milky Way protruding from the rest of the arm. "It is only the recent, direct distance measurements from Gaia that make the geometry of this new structure so apparent," said Alberto Krone-Martins, an astrophysicist at the University of California, Irvine. Though this would be a rather gruesome fracture in flesh and bone, in cosmic terms, this area is spectacular, filled with star-forming vistas. The analysis shows that four famous deep-sky objects —-the Eagle Nebula (M16), the Omega Nebula (M17), the Trifid Nebula (M20), and the Lagoon Nebula (M8) - all lie within this structure. Astronomers believe such spurs are formed by a combination of gravity, rotation, and shear. Because these structures bear the imprint of those forces, finding more spurs like this one could help scientists better understand how spiral galaxies form their graceful, curving arms. By: Hailey Rose McLaughlin

The cannibalistic chaos within planetary systems 30 September: Our solar system is well behaved: The set of planets follows near-circular orbits around the sun that do not cross paths or change much. Even the occasional asteroid collisions are relatively peaceful compared to the havoc that likely exists in some of the more than 3,000 planetary systems discovered in our galaxy to date. Somewhere in the Milky Way, a planet could be headed on a collision course with its host star.


Art-Perfect/Shutterstock

The gravitational tug-of-war within planetary systems carves out the paths that planets follow as they orbit their respective star. At any instant, these forces of attraction can change these paths by tiny, barely noticeable amounts. In our solar system, these changes tend to cancel each other out, and the orbits remain relatively stable (even over hundreds of millions of years). In some systems, however, the tiny changes add up over time and alter the orbits significantly, often in unpredictable ways. This chaos runs rampant in such systems, especially early on when planets still seek a stable configuration, says Lorenzo Spina, an astrophysicist at the Astronomical Observatory of Padua in Italy. In the process, planets can migrate through space and end up far from where they initially formed. For example, 'hot Jupiters' have been discovered orbiting close to their stars; these gas giants likely formed farther out and moved inward. And when a planet migrates, it can trigger more dramatic changes in the orbits of nearby planets. In such cases, stable, near-circular orbits can become more elliptical, bringing planets closer to their host star(s).

In a recent study, Spina and his colleagues found that chaos within about a quarter of planetary systems with sunlike stars has altered planets' orbits - to the point of engulfment by its own star. "You wouldn't see a spectacular explosion. But the gravitational force of the star would break the planet into small pieces before it could collide with the star," says Spina. As for the frequency of such an unruly occurrence: "It might be more shocking if a star didn't eat a planet, but prior to this study, there was no way of proving this," says Thomas Burbine, director of the Williston Observatory at Mount Holyoke College, who was not involved in the study. Spina's team worked around this hurdle by analysing binary stars, which are pairs of stars that orbit each other. In these systems, both stars should theoretically possess the same chemical composition if they formed in the same region of space. Therefore, the pairs in which one star has more iron and lithium indicate planet-eating. "If you have one star, you don't know if it formed with that chemical signature. But using binary stars to check for planetary engulfment is clever," says Burbine.

To search for other planets that can support life, it could help to examine the chemical composition of sunlike stars to check for evidence of planetary engulfment. This strategy might rule out systems that are too unruly to support Earthlike planets. If the planets' orbits keep changing then the potential for life decreases, according to Burbine, because this is associated with a greater chance of extinction-level collisions. "If you want to look for life, you want things to be peaceful," he explains. Interestingly, the sun's chemical composition could include less iron and lithium than nearby stars. A potential explanation: These planetary systems have experienced planet-swallowing events whereas our solar system hasn't - at least not in the past few billion years. "Every planetary system is very chaotic early on, and then it will or won't find a stable configuration," says Spina. In this sense, our sun could appear peaceful if an extraterrestrial civilization were to analyse the composition of stars - perhaps until when the sun becomes unruly and wells into a red giant star 5 billion years from now (possibly devouring Earth). That is a very long time away.

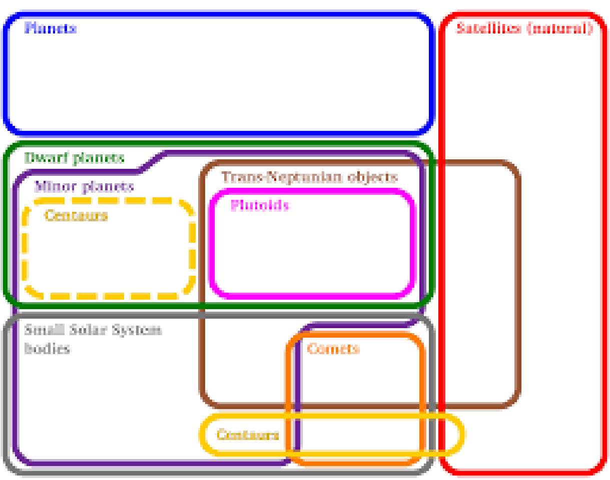
By: Theo Nicitopoulo

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

DID YOU KNOW?

Solar system objects Part 3: Overview (3)

Dwarf planets



A dwarf planet is a planetary-mass object which does not dominate its region of space. Like a planet, it orbits the Sun and is massive enough to be rounded by its own gravity. However, it is not massive enough to have cleared its neighbourhood region of small objects. It is also smaller than the smallest planet, Mercury.

This new category was introduced at the 2006 meeting of the International Astronomical Union. The decision has proved controversial as it led to the demotion of Pluto, then the ninth and most distant of the planets. The underlying issue was that an increasing number of such objects had been found. Unless the number of planets in the solar system was to increase to more than a dozen, and counting, a new grouping was needed.

The new category includes the largest object in the asteroid belt (Ceres) and the largest trans-Neptunian object (Pluto). The number of dwarf planets in the solar system is not known. Currently, nine are recognised, but there are several other candidates, too. The challenge is to determine the masses of these normally very distant objects, located in the Kuiper Belt. The process is made easier when they have moons, which several do, as this facilitates calculation of their mass and densities, but it still a challenge.

Even the accepted size of known dwarf stars can change. It took the New Horizons mission to determine, during a flyby in 2015, that Pluto is, in fact, slightly larger than Eris. Until then, for some time, because it is brighter, it had been claimed that Eris was the larger of the two.

The conditions for classification as dwarf plaents have raised some interesting situations. For example, there are several moons also called 'planetary- mass moons', including Earth's Moon. Massive enough to have spherical shapes, some, like Ganymede (Jupiter) and Triton (Saturn) are actually larger than planet Mercury. However, because they do not orbit the Sun, they are classified as moons rather than dwarf planets.

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,

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