"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

JULY 2018

Monthly meeting This month's meeting will place on **Monday 16 July** at the **Catholic Church Hall** starting at **19.00**. Centre member, Johan Retief, will be talking on the 'History of the Voyager spacecraft. See below for more details.

Stargazing Weather permitting, a stargazing evening is scheduled to take place on **Saturday 14 July** from 18.30 in the grounds of the NG Kerk in Onrus.

Monthly meeting: change in October presenter Centre member, John Retief will give a second presentation this year. See below for details.

WHAT'S UP?

Total lunar eclipse This will take place during full moon on the 27th, running into the 29th. Like all lunar eclipses, it will be visible to all experiencing night-time when the eclipse occurs. The 'eclipse' is that of Earth blocking sunlight from reaching the moon. There are two parts to the Earth's shadow, the dark inner umbra where sunlight is completely obscured, and lighter outer penumbra where sunlight is only partly obscured. The average length of the total part of a total lunar eclipse is around 100 minutes. Weather permitting, it will be possible to observe the start of the eclipse at 19.14 and final contact with the penumbra on the opposite side at 01.29 on the 28th. The total eclipse (umbral entry) will begin at 21.29 and end at 23.13. As the Moon darkens while crossing the umbra,, it does not always appear black. In fact, it often appears coppery, orange or reddish in colour. The red nature of this colour is a result of sunlight being scattered and reflected by Earth's atmosphere into the shadow. This month's eclipse will be the second total lunar eclipse of 2018. The one at the January was not visible from southern Africa.

LAST MONTH'S ACTIVITIES

Monthly centre meeting At the meeting held on 18 June, Centre chairman, Pierre de Villiers, presented a 'Photographic documentary and verbal memory of the first ten years' of the Hermanus Astronomy Centre. The stated vision of the then Hermanus Astronomy Club was 'A Hermanus community knowledgeable about the southern skies'. This very enjoyable snapshot of the Club/Centre's activities during its first decade reminded attendees how much has been done towards achieving this vision. Pierre grouped the material under the headings of regular activities, outreach, and initiatives.

Regular activities included not only ongoing events like monthly meetings and the various interest group meetings, but the earlier series of beginners events and a telescope observation programme. They also included public and learner stargazing events, and trips to Sutherland, Carnarvon, Cape Town and the Cederberg. The Centre was involved in numerous outreach activities. These included National Science Week, workshops with Overberg science teachers and learners, youth group meetings and workshops at local schools, and public observation events for eclipses and transits. Initiatives included the sundials and solar system model erected in public spaces and along the cliff path, the planned AECA, naming of Asteroid Hermanus and youth robotic telescope imaging.

Murmurs of recognition and memory jogging were heard from members as Pierre presented a wide range of photographs taken at numerous events and places. One member commented that it had been 'fun' to have all these reminders, a good portent for the future of the Centre.

Interest groups

Cosmology Those who attended the meeting on 4 June watched the next two episodes of the new DVD series: The Higgs boson and beyond by Dr Sean Carroll, Research Professor of physics at CalTech. These episodes were Lecture 9: 'The Large Hadron Collider' and Lecture 10: 'Capturing the Higgs boson'.

Astro-photography Those who attended the meeting on 25 June continued work on processing their own astro-images.

Other activities

Educational outreach

Hawston Secondary School Space Cadets Meetings with the new group of space cadets continued during May.

Lukhanyo Youth Club No meeting took place in April.

Whale Talk article An article by Jenny Morris titled 'Space debris: a challenge being met' was published in the June/July issue of the magazine.

THIS MONTH'S ACTIVITIES

Monthly centre meeting This month's meeting, will take place on **Monday 16 July** at the **Catholic Hall** starting at **19.00**. Centre member, Johan Retief, will be talking on the 'History of the Voyager spacecraft' Johan has been the Centre's most prolific speaker, his presentations always interesting and informative. They are also always enjoyable, peppered with humour. This talk on the spacecraft launched over 50 years ago, but still travelling in space will, undoubtedly, be equally good.

There is an entrance fee of R10 per person for members, R20 per person for non-members, and R10 for children, students and U3A members.

Interest group meetings

The **Cosmology** group meets on the first Monday of each month at 19.00. The next meeting will take place on **2 July** at the **Catholic Hall**, starting at **19.00**. Attendees will watch the final two episodes in the DVD series: The Higgs boson and beyond by Dr Sean Carroll, Research Professor of physics at CalTech. The content will be Lecture 11: 'Beyond the Standard Model of particle physics' and Lecture 12: 'Frontiers: Higgs in space'.

There is an entrance fee of R10 per person for members, R20 per person for non-members, and R10 for children, students and U3A members. For further information on

these meetings, or any of the group's activities, please contact Pierre Hugo at pierre@hermanus.co.za

Astro-photography This group meets on the second Monday of each month. The next meeting is on **9 July.** The topic will be 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 Organisers are progressing with work towards enabling learners to take and process images themselves.

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

Stargazing The next planned event is scheduled for **Saturday 14 July.** Weather permitting, it will start at 18.30 in the grounds of the NG Kerk in Onrus.

FUTURE ACTIVITIES

Cederberg trip The 12-14 October trip to the Cederberg is fully booked. Please contact John Saunders at antares@hermanus.co.za with any queries.

2018 MONTHLY MEETINGS

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

16 July	'History of the Voyager spacecraft' Presenter: Johan Retief, Centre member
20 August	Topcic: astro-photography. Presenter: Pete Scully
17 September	'Gravitational waves: the new frontier in astronomy' Presenter: Dr David Buckley, SAAO, Cape Town
22 October	'The Fermi paradox and its implications for extraterrestrial life' Presenter: Johan Retief, Centre member
19 November	'Table Mountains: geology and astronomy' Presenter: Jenny Morris, Centre member
10 December	Xmas party

ASTRONOMY EDUCATION CENTRE AND AMPHITHEATRE (AECA)

Consideration of the planning application by the Council of Overstrand Municipality continues to be awaited. In the meantime, the Friends of the Observatory pledge fund continues to be an important source of funds to cover associated costs.

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, something which is still awaited.

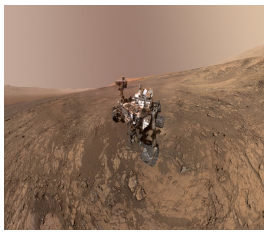
We would, therefore, be very grateful if members could either continue to contribute to the campaign or start becoming a contributor. Both single donations and small, regular monthly donations, of any amount, are welcome. Contributions can take the form of cash (paid at meetings), or online transfer,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

Curiosity rover finds organics hidden in Mars' mudstones and methane in its atmosphere 7 June: NASA has announced its Curiosity rover had uncovered new evidence of methane - a potential sign of life - as well as signs of organic compounds buried in ancient mudstone. The space agency did not say it had found evidence of alien life. However, these new results are still tantalising.



Selfie of Curiosity Rover taken on Vera Rubin Ridge. NASA/JPL-Caltech/MSSS

Curiosity landed on Mars back in 2012 and it hss been slowly climbing up Mount Sharp, a large hill formed when an asteroid impact created Gale Crater, simultaneously exposing multi-billion year old sedimentary rocks laid down in an ancient lake bed. The rover came equipped with a suite of instruments known as Sample Analysis at Mars, or SAM. Its main goal was to find organic molecules. These commonly form in non-biological processes, but they are also the building blocks of life. Mysteriously, the VW Beetle-sized rover succeeded in finding organics even though past Mars missions, like 1976's Viking landers, did not.

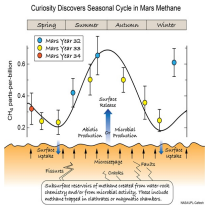
This latest announcement was tied to two scientific papers published simultaneously in the prestigious journal *Science*. One study focused on the methane and the other looked at the organics. In the first paper, a team analysed three Mars years worth (55 Earth months) of atmospheric data from Curiosity. In that time, the rover caught methane levels spiking as the seasons changed, growing several times stronger at the height of summer in the northern hemisphere. Based on the chemical make-up, the scientists suspect this methane was heated up and released from sub-surface reservoirs where it was likely trapped in permafrost. They suspect large amount of the gas may be frozen in such underground reservoirs. However, its exact origin remains a mystery.

The other study, led by NASA biogeochemist Jennifer Eigenbrode, examined drill samples of three-billion year old mudstones that Curiosity collected from two different sites in Gale Crater. The rover dropped these samples into an onboard laboratory and cooked them in order to analyse the gasses they threw out. According to Eigenbrode's team, the rocks released organic molecules much like those found in organic-rich rocks on Earth.

This is far from the first time Mars researchers have claimed to find methane. Curiosity itself made headlines in recent years after seeing faint methane signals. Scientists have been chasing this gas for decades. In 1966, a pair of astronomers made a startling announcement during a conference at San Francisco's Jack Tar Hotel. They had used a special kind of ground-based telescope to study the atmosphere of Mars, and in the process, they had deduced the presence of methane. Headlines heralded the significance:

Life could exist on Mars. In the half-century since then, many teams of scientists have published potential signs of methane in Mars' atmosphere. Each of those sparked hope for finding life, only to fade away without further proof.

"Every chapter in the story of methane on Mars has been a surprise," says JPL's Chris Webster, who led the methane study. But, each of those signals was sporadic, and "none of them were repeatable." This time, they were able to watch the signal come and go. So the find looks destined to stick. What is far less certain is exactly what it means.



Methane is a simple molecule - a so-called hydrocarbon - composed of four hydrogen atoms stuck to one carbon atom. It has no natural smell or colour. It is also common because hydrogen is the most abundant element in the cosmos, and carbon is the third most abundant. However, it is also fragile. It cannot handle things too hot, and the oxygen and carbon dioxide in Earth's atmosphere can break its bonds. So, on Earth, methane does not last long in our atmosphere.

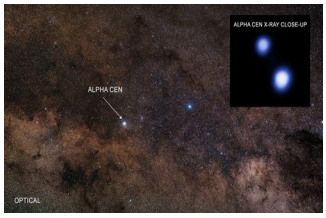
Most of the methane that we do have is produced by biology. Things die and their hydrocarbons get trapped in stores deep underground or in permafrost, where it's known as a clathrate. Living things also churn out methane, too. Cows and other livestock produce enormous amounts of the greenhouse gas. In addition, simple lifeforms, known as methanogens, also produce methane. All this means that, on Earth, methane is a sign of life. That has given astronomers good reason to see methane as a potential signal of microbes on Mars.

Like Earth, it also has methane-destroying conditions. The Red Planet's atmosphere is almost completely made of carbon dioxide, and even the ultraviolet light that penetrates Mars' weak atmosphere could destroy it. So, any methane we do see must have been released into the atmosphere very recently.

Llife is not the only process that makes methane. We know that because it is abundant on Uranus and Neptune, and there is enough of the stuff to create bizarre landscapes on the surfaces of Pluto and Titan. Even on Earth, a small amount of methane is made in specific sorts of volcanic reactions, even if it does nt stick around long. However, Mars has no active volcanoes. Also, it does not have ways of replenishing methane like those outer solar system worlds. To truly find out what is causing these seasonal surges of methane, we need new Mars missions capable of better searching for definitive signs of life. Thankfully, those spacecraft are already in the works. NASA's Mars 2020 rover, which will launch in a couple years, is custom-built for this purpose, and the European Space Agency's ExoMars rover should soon follow with similar aims. By: Eric Betz

Alpha Centauri system could have favourable conditions for life 8 June: The search for habitable exoplanets spans far and wide, pushing the limits of what our modern telescopes are capable of. Researchers have also kept diligent eyes on Alpha Centauri, the

closest system to Earth that happens to house Sun-like stars. Now, a comprehensive study clears Alpha Centauri's two brightest stars of a crucial habitability factor: dangerous X-ray radiation.



Alpha Centauri is the closest star system to Earth, X-ray: NASA/CXC/University of Colorado/T.Ayres; Optical: Zdeněk Bardon/ESO

In the study, NASA's Chandra X-ray Observatory observed the three stars of Alpha Centauri, which sits just 4 light-years from Earth, twice a year since 2005. In an effort to determine the habitability of any planets within their orbits, Chandra monitored the amount of X-ray radiation that each star emitted into its habitable zone. An excess of X-ray radiation can wreak havoc on a planet by dissolving its atmosphere, causing harmful effects for potential residents, and creating destructive space weather that could mess with any technology possibly in use. Thankfully, the potential planets orbiting two of the three stars do not have to worry any of that. In fact, these stars may actually create better planetary conditions than our own Sun. "Because it is relatively close, the Alpha Centauri system is seen by many as the best candidate to explore for signs of life," said study author, Tom Ayres of the University of Colorado Boulder. "The question is, will we find planets in an environment conducive to life as we know it?"

The three stars that make up Alpha Centauri are not exactly created equal, with some more hospitable to life than others. The two brightest stars in the system are a pair known as Alpha Cen A and Alpha Cen B (AB for short), which orbit each other so closely that Chandra is the only observatory precise enough to differentiate their X-rays. Farther out in the system is Alpha Cen C, known as Proxima, which is the closest non-Sun-like star to Earth. The AB pair are both remarkably similar to our Sun, with Alpha Cen A almost identical in size, brightness, and age, and Alpha Cen B only slightly smaller and dimmer.

Regarding X-ray radiation, Alpha Cen A actually provides a safer planetary environment than the Sun, emitting lower doses of X-rays to its habitable zone. Alpha Cen B creates an environment that is only marginally worse than the Sun, releasing higher amounts of X-rays by only a factor of five. "This is very good news for Alpha Cen AB in terms of the ability of possible life on any of their planets to survive radiation bouts from the stars," Ayres said. "Chandra shows us that life should have a fighting chance on planets around either of these stars."

Proxima is a different story, though. It is a significantly smaller red dwarf that emits about 500 times more X-ray radiation into its habitable zone than Earth receives from the Sun, and can radiate 50,000 time more during the massive X-ray flares that it's known to hurl into space. While the AB duo's X-ray radiation is not a threat to life, the massive dose expelled by Proxima definitely is. Unfortunately, the only exoplanet that has been identified in Alpha Centauri is orbiting uninhabitable Proxima.

Researchers have not given up hope, though. They continue to search for exoplanets around the AB pair, although their tight orbit makes it difficult to spot anything in between

the two. Even if the search continues to turn up empty, Chandra's extensive investigation will help researchers study the X-ray radiation patterns of stars similar to our Sun, allowing us to pinpoint any potential threats to Earth. And if we do come across planets orbiting these two stars, we might just find signs of life in our own backyard. By: Amber Jorgenson

Giant dust storm engulfs Opportunity rover 15 June: NASA's Curiosity Mars rover has enjoyed major headlines lately with some new discoveries that bring us one step closer to the detection of ancient life on Mars. However, while Curiosity is enjoying this well-earned moment in the spotlight, its fellow rover and older cousin, Opportunity, has fallen silent. Opportunity is smack dab in the middle of a massive dust storm blanketing at least one-quarter of the Red Planet, alone under dark skies as dust blots out the precious sunlight the rover needs for power. The storm was not a complete surprise; Mars is now entering a dust-storm season, as planetary scientists have expected. Martian dust storms range from small - less than 1,930 km across - to much rarer huge, planet-spanning storms that can cover one-third to one hundred percent of the surface.


Opportunity and its sister rover, Spirit, landed on the martian surface in 2004. NASA/JPL/Cornell University, Maas Digital LLC

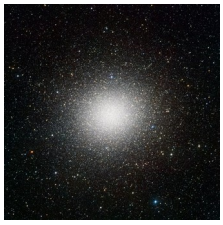
This particular storm was first detected on 30 May by NASA's Mars Reconnaissance Orbiter (MRO). At the time, it was about 1,000 km from Opportunity, but the rover's team began developing contingency plans in case the storm advanced. It did. By 6 June, dust had begun obscuring the sunlight needed for the rover's solar panels to churn out power, dropping the rover's capacity to carry out extended tasks. Over the course of two days, Opportunity's ability to generate energy dropped by half. That level dropped by half again in a single day. On 10 June, the rover transmitted data back to Earth showing the opacity of Mars' atmosphere (a measure of dust) was currently twice as high as had ever been measured previously on the planet.

The rover has been silent since then, and team members have been unable to communicate with it after 10 June. The team is now assuming Opportunity has gone to sleep, waiting out the storm until the atmosphere clears and it can once again charge its power supply. While 'asleep' - in what engineers call low power fault mode - all of the rover's systems, save a mission clock, are off. The clock will periodically wake the rover to determine whether the batteries have collected enough charge (which will happen once the solar panels are again exposed to sunlight). If not, the rover will go back to sleep.

This is not the first time Opportunity has gone to sleep to weather a Martian storm. The last time was in 2007, when the rover was a spry three years old, and only about 1,000 days past its planned 90-day mission warranty. Now, Opportunity is nearly 15, more than 5,000 days past that initial warranty period. In 2007, Opportunity maintained minimal power operations for two weeks, and went to sleep for several days before contact was re-established. Today, its mission team is hoping that the little rover will again prevail.

By: Alison Klesman

Globular clusters may be younger than we thought 18 June: Globular clusters are spherical associations of old stars, thought to have formed during the earliest days of our universe, nearly 14 billion years ago. They contain some of the oldest stars in our galaxy, and the same appears true for other galaxies as well. However, new research led by astronomers at the University of Warwick is now challenging this belief, showing that globular clusters may be a full 4 billion years younger than previously thought. Their paper states that globular clusters may be closer to 9 billion years in age than the previously measured value of 13 billion years.


The Milky Way globular cluster Omega Centauri . ESO/INAF-VST/OmegaCAM; Acknowledgement: A. Grado, L. Limatola/INAF-Capodimonte Observatory

How did this age discrepancy arise? The age of globular clusters has long been determined by studying the light from their stars. Astronomers compare the properties of the integrated (total) light received from globular clusters with templates of starlight produced by stars of different ages and types. (It is worth noting that, at one point, these models showed that globular clusters were older than the universe, so this would not be the first time astronomers have updated their age estimates for these objects.)

This new study takes a different approach, using new models called Binary Population and Spectral Synthesis (BPASS) models, which take into account the effects of binary stars and how the evolution of binary systems - which are known to be common - affects the light received from globular clusters. The idea is this: interactions between binary stars can change the properties of the starlight emitted by one star as elements from its atmosphere are stripped away by the gravity of a companion. When taken into account these binary interactions could make the starlight coming from globular clusters look more like the older templates used by astronomers to determine stellar age, prematurely aging the cluster.

"Determining ages for stars has always depended on comparing observations to the models which encapsulate our understanding of how stars form and evolve," said lead author Elizabeth Stanway of the University of Warwick's Astronomy and Astrophysics Group. "That understanding has changed over time, and we have been increasingly aware of the effects of stellar multiplicity - the interactions between stars and their binary and tertiary companions."

BPASS models have previously been used to successfully determine the age of young stellar populations, both within the Milky Way and in extremely distant galaxies, but even with this age revision, globular clusters are still old. The next step, Stanway said, is to look at nearby globular clusters in which individual stars can be seen (faraway clusters just look like fuzzy balls, so all astronomers have to work with is the total light from all their stars together). Studying nearby clusters in better detail and comparing these results with the BPASS models should bring to light the accuracy of the models and this new age measurement. "If true," she said, "it changes our picture of the early stages of galaxy

evolution and where the stars that have ended up in today's massive galaxies, such as the Milky Way, may have formed." By: Alison Klesman

Einstein proven right even in other galaxies 21 June: Albert Einstein revolutionised physics when he was in his 20s and 30s. He came up with a whole new way of understanding reality, not as a fixed grid against which events occur, but as fundamentally intertwined with time and perception. Trying to prove Einstein wrong, somehow, is a perennial goal of budding and experienced physicists alike. They will have to keep trying. A new study shows that Einstein was so good, even in distant galaxies he is still right.


Galaxy NGC 3344. NASA/ESA

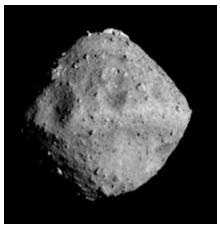
It all has to do with general relativity, Einstein's theory of gravity, which posits that anything with mass warps the fabric of spacetime. The bigger the mass, the more the very universe deforms around it. This explains why massive objects attract less massive objects: they are just following spacetime's curves. Light also follows the warps and wefts created by gravity - black holes and galaxies literally bend light around them.

Sometimes, when massive enough objects line up just right, they can actually focus more distant light like a glass lens in a telescope, with the bends in space-time acting as a kind of 'gravitational lens'. While these are useful in studying those ultra-distant objects emitting that warped light, they can also serve as a 'laboratory' for testing relativity itself. That's important, because even though scientists have confirmed Einstein's general relativity within the solar system, that is still small potatoes compared to the larger universe. As the paper's authors write, "the long-range nature of gravity is still poorly constrained." So they found a way to use a nearby gravitational lens around galaxy ESO 325-GOO4 to test out relativity on the galactic scale.

First, the team measured just how much the galaxy was warping spacetime, using Hubble data of the area. This allowed them to derive the galaxy's mass. Then, they calculated the mass a different way, by observing stellar movement, this time using data from the Very Large Telescope in Chile. If Einstein was right, the two figures should be about the same. Einstein was right. The ratio between the two values was 0.97 ± 0.09, which is pretty close to the predicted value of 1. This is great news not just for Einstein supporters, but anybody who wants to understand what is going on in the universe at large scales. The finding rules out many alternative theories of gravity, and confirms that even at large scales general relativity holds true. It also means we have to keep around the notion of dark energy - the still mysterious force propelling the universe to expand faster and faster - since it is (partly) a consequence of general relativity. By: Bill Andrews

Japan's Hayabusa-2 will soon punch an asteroid 26 June: JAXA's Hayabusa-2 spacecraft is quickly approaching Ryugu, an asteroid who could provide crucial clues to the formation and evolution of our solar system. The craft set off on its 5.24 billion km round-trip journey in late 2014, and is now within just 40 km of the asteroid. Once it

arrives, it will use an extensive array of instruments to dissect Ryugu's composition and study its physical properties. Most excitingly, it will bring a small selection of samples back to Earth, thanks to an instrument that first punches a projectile into the asteroid's surface and then collects a portion of the resulting debris.


On 24 June, Hayabusa-2 snapped a shot of Asteroid 1993 JU3, known as Ryugu, from a distance of just 40 km. JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University, Chiba Institute of Technology, Meiji University, Aizu University, AIST

Ryugu, formally named 1993 JU3, is an estimated 920m asteroid that orbits between Earth and Mars, and based on spectroscopic data, likely houses a great deal of hydrated material. Researchers believe that these C-type asteroids could have been ancient vehicles that transported molecules throughout the solar system, delivering chemical elements to celestial residents. To test this theory, Hayabusa-2 embarked on a mission to examine Ryugu's composition.

The craft will use its near infrared spectrometer to analyse the abundance of hydrated material, and will also use a thermal infrared imager to record variations in surface temperature and thermal emissions. The data will shed light on its physical properties and help uncover how the asteroid formed and evolved. Hayabusa-2 will also deploy four landers: One, the MASCOT lander, will use an infrared microscope and wide-angle camera to record Ryugu's structural, compositional and surface characteristics, and also document its energy balance and thermal inertia. Remaining are a series of three MINERVA-II landers, each equipped with cameras and temperature sensors, which will travel across Ryugu and record surface temperatures at different times and locations.

The most exciting instrument, though, is the sampler mechanism. It will create a 4m wide crater by shooting a projectile into the asteroid's surface and ejecting pieces small enough to bring back to Earth. By blasting into the exterior and exposing the sub-surface, researchers will be able to study parts of Ryugu that have not been exposed to intense heat and radiation. The mission will spend about a year and a half carrying out its research, and is expected to return in 2020. Hayabusa-2 is following in the footsteps of its predecessor, Hayabusa, which became the first mission to collect and deliver asteroid samples to Earth back in 2010. By: Amber Jorgenson

Cassini finds massive organic molecules in Enceladus' plumes 27 June: A new analysis of data from two instruments aboard the now-perished NASA Cassini spacecraft orbiter, an international team of researchers looked at molecules erupting with plumes of water vapour streaming from beneath Enceladus' surface. Though similar experiments have been performed in the past, this time, the researchers found organic molecules much bigger, and thus more complex, than any found before.


Saturn's moon Enceladus. NASA

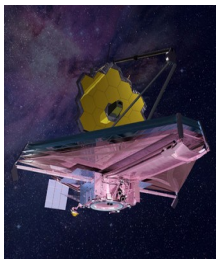
The international team used data from both a mass spectrometer aboard Cassini, which 'tasted' the plume's composition, as well as the Cosmic Dust Analyzer (CDA), which used the impacts of molecules against a sensor to determine their mass. About three percent of the molecules they sampled approached the limits of the sensor's detection range at 200 atomic mass units, or more than 10 times heavier than methane. Though researchers have found organic molecules elsewhere in the solar system, the sheer size of those on Enceladus is surprising. Combined with the moon's other intriguing characteristics - a salty liquid water ocean, geysers emanating from beneath the surface and indications of hydrothermal vents - Enceladus continues to look like the most tantalising place in our solar system to look for extraterrestrial life.

The presence of large, complex organic molecules is something we would expect to see if life was present. However, it ss also far from evidence of actual life. In chemistry, organics are simply molecules that life uses, usually including carbon and often with large ring or chain structures incorporating oxygen, nitrogen and hydrogen. Organic molecules can come from non-organic processes too, and the researchers suggest that those on Enceladus could simply have either been incorporated into the moon since its formation, or come about as a result of reactions within the planet's rocky core - perhaps assisted by geothermal activity. We cannot rule out the possibility of life on Enceladus, either. The researchers note that some of the macromolecules they found seem similar to some created on Earth by the decay of organic matter. As always, though, there are totally abiotic pathways that could create these molecules as well.

Further explorations of Enceladus will have to wait. The Cassini spacecraft crashed into Saturn last year and, despite efforts to send a follow-up mission to Enceladus, none is currently planned. The trove of data from Cassini is all we have to work with.

By: Nathaniel Scharping

NASA completes Webb Telescope review, commits to launch in early 2021 27 June: The Independent Review Board (IRB) established by NASA to assess progress on its James Webb Space Telescope has unanimously recommended that development on the world's premier science observatory should continue; NASA has established a new launch date for Webb of 30 March 2021. The board also reaffirmed Webb's significant complexity, incredible scientific potential, and importance to astrophysics. The report includes several recommendations for moving forward, some of which NASA has already initiated.


NASA

The IRB found that technical issues, including human errors, have greatly impacted the development schedule. NASA previously had estimated an earlier launch date, but awaited findings from the IRB before making a final determination and considered data from Webb's Standing Review Board. The agency established the new launch date estimate to accommodate changes in the schedule due to environmental testing and work performance challenges on the spacecraft's sunshield and propulsion system. The telescope's new total lifecycle cost, to support the revised launch date, is estimated at $9.66 billion; its new development cost estimate is $8.8 billion.

From detecting the light of the first stars and galaxies in the distant universe, to probing the atmospheres of exoplanets for possible signs of habitability, Webb's world-class science not only will shed light on the many mysteries of the universe, it also will complement and further enhance the discoveries of other astrophysics projects. The first telescope of its kind, and an unprecedented feat of engineering, Webb is at the very leading edge of technological innovation and development. At its conception, challenges were anticipated for such a unique observatory of its size and magnitude. Webb was designed with highly sophisticated instruments to accomplish the ambitious scientific goals outlined in the National Academy of Sciences 2000 Decadal Survey – to answer the most fundamental questions about our cosmic origins

Webb will be folded, origami-style, for launch inside Arianespace's Ariane 5 launch vehicle fairing – about 5m wide. After its launch, the observatory will complete an intricate and technically-challenging series of deployments – one of the most critical parts of Webb's journey to its final orbit, about 1,6 million km from Earth. When completely unfurled, Webb's primary mirror will span more than 6.5m and its sunshield will be about the size of a tennis court. Because of its size and complexity, the process of integrating and testing parts is more complicated than that of an average science mission. Once the spacecraft element has completed its battery of testing, it will be integrated with the telescope and science instrument element, which passed its tests last year. The fully-assembled observatory then will undergo a series of challenging environmental tests and a final deployment test before it is shipped to the launch site in Kourou, French Guiana. By: NASA

Speeding interstellar object 'Oumuamua is a comet, not an asteroid 29 June: Ever since Rob Weryk first spotted 'Oumuamua zipping through the solar system in October 2017, the peculiar object has been the target of intense scrutiny for astronomers from around the globe. After confirming the suspected asteroid reached a maximum speed of nearly 200,000 miles per hour during its closest approach to the Sun (and is shaped like a cigar), researchers quickly shifted their focus to determining the composition and origin of this mysterious object.


'Oumuamua, the first-known interstellar interloper, is seen venting gas and dust in this artist's concept. ESA/Hubble, NASA, ESO, M. Kornmesser

In a study, astronomers suggested that 'Oumuamua may be an asteroid that flew by our solar system after being ejected from a binary star system. Now, by combining telescopic data from the Hubble Space Telescope and other ground-based observatories, an

international team of astronomers has shown that ʻOumuamua is indeed a speed-boosted comet rather than an asteroid, which is what astronomers previously thought. Researchers have determined that ʻOumuamua is slowly and steadily accelerating away from the Sun, which means it is currently travelling faster than is predicted by celestial mechanics - a very well-understood branch of astronomy that deals with the motions of cosmic objects. "Our high-precision measurements of ʻOumuamua's position revealed that there was something affecting its motion other than the gravitational forces of the Sun and planets," said team-lead Marco Micheli of the European Space Agency.

The researchers explored a number of possible scenarios in an attempt to explain the faster-than-expected speed with which ʻOumuamua is hurtling out of the solar system. After considering all the possibilities (such as solar-radiation pressure, friction-like forces, and magnetic interactions with the solar wind), the team concluded the most likely explanation is that the Sun is causing ʻOumuamua to vent gas and dust from its surface in a process called outgassing, which almost exclusively occurs in icy comets, not rocky asteroids. This ejection of material - which is caused by the Sun evaporating or sublimating the gases trapped just below ʻOumuamua's surface - generates a tiny amount of thrust. And though this outgas-induced thrust is small, according to the researchers, it is enough to account for ʻOumuamua's observed boost in speed. "We think this is a tiny, weird comet," said Marco Micheli. "We can see in the data that its boost is getting smaller the farther away it travels from the Sun, which is typical for comets."

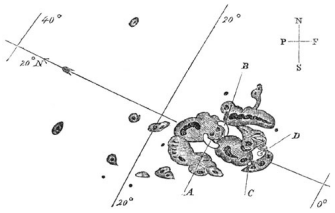
However, the researchers point out that ʻOumuamua does not seem to be outgassing like most other comets found within the solar system. Specifically, when comets from our solar system are heated by the Sun, outgassing typically leads to the ejection of *visible* material, which forms a hazy cloud around them called a coma, plus a characteristic tail. However, for ʻOumuamua, researchers found no visual evidence of these features. "We think that ʻOumuamua may vent unusually large, coarse dust grains," said Karen Meech of the University of Hawaii. These large dust grains - which, surprisingly, are more difficult to spot than smaller grains - may be faint, but they are also massive enough that their ejection generates sufficient thrust to account for the unexpected increase in ʻOumuamua's speed. Furthermore, the researchers propose that ʻOumuamua may be ejecting large grains because all of the smaller dust grains that adorn most cometary surfaces already eroded away during its long trek through interstellar space.

Although the suspected outgassing seems to tell us a bit about the composition of ʻOumuamua, unfortunately, it also makes determining the origin of this puzzling object that much more challenging. "The true nature of this enigmatic interstellar nomad may remain a mystery," said co-author Olivier Hainaut of the ESO. "'Oumuamua's recently detected gain in speed makes it more difficult to be able to trace the path it took from its extrasolar home star." By: Jake Parkes

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

DID YOU KNOW?

The Sun Part 28: **1859 Carrington event**



Sunspots recorded by Richard Carrington, 1859


Aurora borealis

On 1 September 1859, English astronomer Richard Carrington continued the daytime heliographic measurements of sunspots from his observatory in Surrey, which he had begun in 1857. Sunspot number had been very high ever since 28 August, but, on this particular day, he became one of the first two people to independently make the first observation of a solar flare. The other observer was Richard Hodgson, an amateur astronomer with an observatory in Essex.

What they saw, with the naked eye on a projection of the Sun through a telescope onto a screen, was a 'white light flare' in the Sun's photosphere. When Carrington learned that the nearby Kew Observatory magnetometer had concurrently recorded a crochet, an instantaneous perturbation of Earth's ionosphere, he connected the two, identifying that the flare he had observed was associated with the numerous sunspots he had observed during previous days and the terrestrial effects which had been experienced on Earth.

The flare was associated with a massive coronal mass ejection (CME) which had begun the 150 million km journey from the Sun 18 hours earlier (normally it takes 3-4 days for a CME to reach Earth). It was proposed that this great speed was facilitated by an earlier CME which had 'cleared the way' a few days earlier.

The CME which produced the flare on 1 September 1859 was part of the largest geomagnetic storm ever recorded by ground-based magnetometers. During the 1-2 September storm, aurorae were visible around the world, those in the Northern Hemisphere observed as far south as the Caribbean and sub-Saharan Africa. The auroral light was so bright that it woke miners in the Rocky Mountains, leading them to think it was morning. Others in the southern USA could read the newspaper at night. In the Southern Hemisphere, aurorae were visible as far north as northern Queensland and southern Papua New Guinea. Although no records exist, it is possible that they were even visible to those at high altitude on the equator.

However, the effects of the geomagnetic storm were not all positive. Telegraph systems across Europe and North America failed due to large induced voltage increases, sometimes giving operators electric shocks and setting light to wooden telegraph poles.

Ice core analysis has identified that large-scale events occur approximately once every 500 years. Although there have been more recent massive geomagnetic storms, eg 1882, 1921 and the 1989 event which caused collapse of power grids and blacked out parts of eastern Canada, fortunately, so far, they have not been as powerful or as destructive. Estimates are that if another 1859 event occurred in modern times, the cost to the US alone would be $0.6-2.6 trillion. It is, therefore, very fortunate that the trajectory of the 'Carrington-class' solar superstorm of 23 July 2012 missed Earth.

Carrington's observations and records of sunspots and solar activity earned him a lasting legacy. Although he did not discover the 11-year solar cycle, the system of numbering cycles carries his name eg the 2010 maximum was part of Carrington Cycle No 24. Also,

his work on sunspots led to increased understanding of solar rotation which has established 'Carrington rotation', the system used to identify individual rotations of the Sun.

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

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