New Zenith

The Monthly Newsletter of the Vectis Astronomical Society

Vol 30 Issue 7 — August 2022

When Printed, this Newsletter costs VAS at least £1

Society News

Firstly I must apologise to all members and readers for the delay in getting NZ published over the last few months.

For those who don't know, I work for a company providing tourist information to the Island's many visitors: I hope you can imagine how busy this makes things during the Summer months. Unfortunately, new arrangements for visitors have made things worse for me as it seems many accommodation suppliers are offering many different break periods this year - instead of 7 day stays people are much more able to get 2,3,4 and 5 day stays as well. This leads to more visitors outside the previous Monday and Friday arrival days and has meant little time for me to get the Magazine out.

Annual General Meeting

Please don't forget the AGM this month. It will be held at the Pavilion from 7pm on 26th August.

We always need your support and would love to see a full house at the meeting.

VAS is your Society and we want to keep things active, there is plenty planned for the next year or so and we your assistance. **Please consider volunteering to help.**

Observatory

The plans to modify the space at the observatory have been shown to the NPS&CA who have agreed in principal for us to extend slightly and modify the Observatory dome/roof arrangement as was shown in last month's NZ.

We still need to get proper drawings and plans for final approval from our landlords and planning permission but at least the basic's have been agreed. There's a lot to think about - not least where the money will come from!

As mentioned above this need members to get involved, help spread the load and hopefully keep everything running pretty smoothly like it has done for the last 25years (well almost!)

Please come along to the AGM is you possibly can.

Brian Curd

VAS Website: wightastronomy.org

Submissions or letters to New Zenith are always welcome and should be sent to:

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Sandown
Isle of Wight
PO36 8EE
Tel: 07594 339950 or email: **editor@wightastronomy.org**

Material for the next issue by the 6th of the month please.

Registered Charity No 1046091

Observatory Diary

Monday, 19.30hrs	Members Only and by arrangement Telescope and night sky training.
Thursday	Members (19.30hrs) and Public (20.00hrs). Informal meeting and observing

VAS Website: wightastronomy.org

Contents this Month

2022 Monthly Meetings

Check *http://www.wightastronomy.org/meetings/* for the latest information

Date	Subject	Speaker
26 Aug	**AGM**	No Speaker
23 Sep	Kristian Birkeland - The story of the father of Northern Lights knowledge	Jonathan Clough
21 Oct	Outreach Event	
25 Nov	The UK National Space Strategy	Adam Amara

Observatory Visits Booked

No bookings so far

Please phone me for the current situation (number on the front page)

It would be appreciated if members could avoid using the observatory at these times.

IMPORTANT

Could all VAS members please ensure they notify the Membership Secretary of any change of address.

To ensure our compliance with GDPR rules, we must maintain accurate membership records.

VAS Contacts 2022

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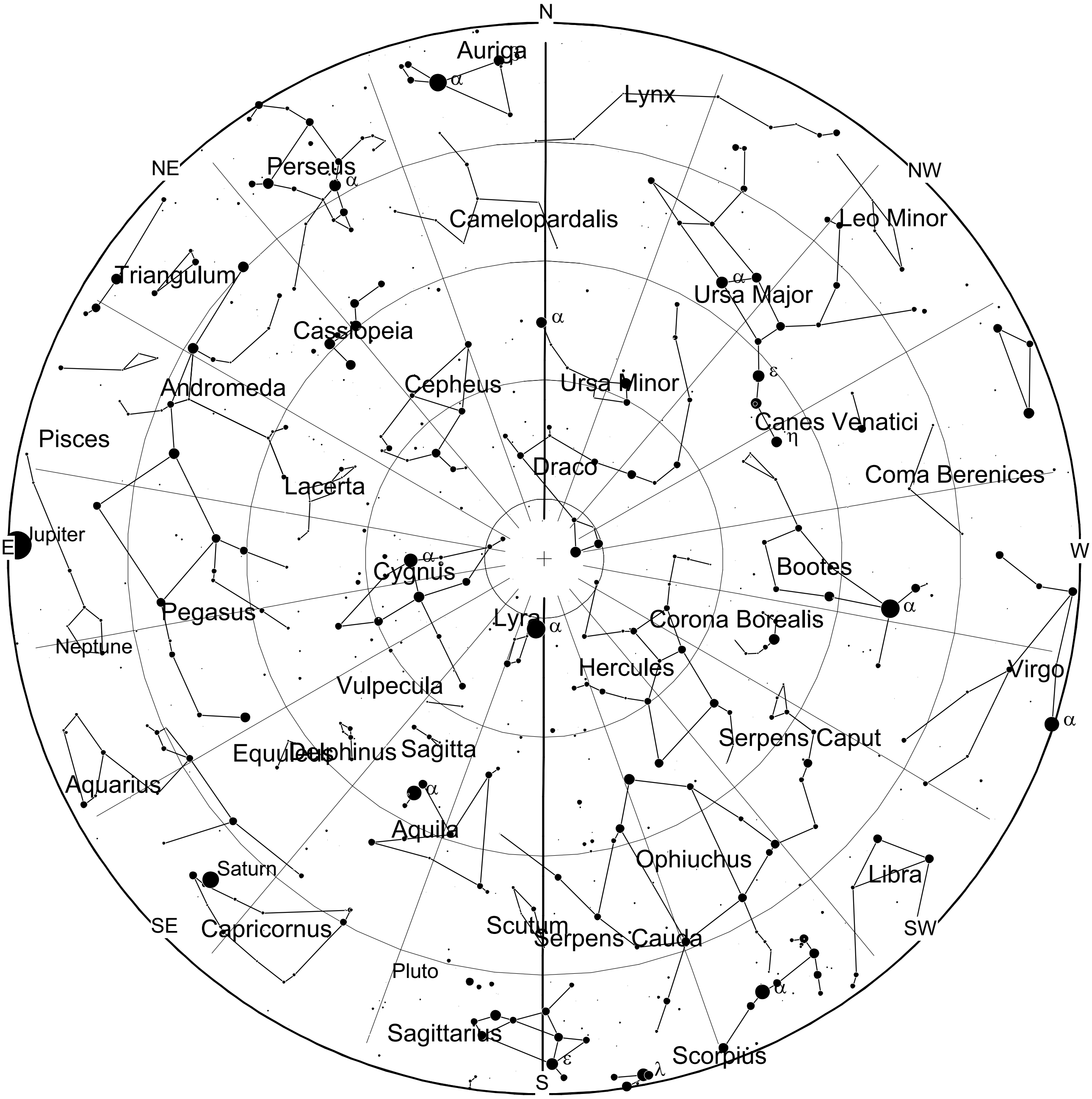
Important

Members using the observatory MUST enter a line or two in the Observatory Log Book.

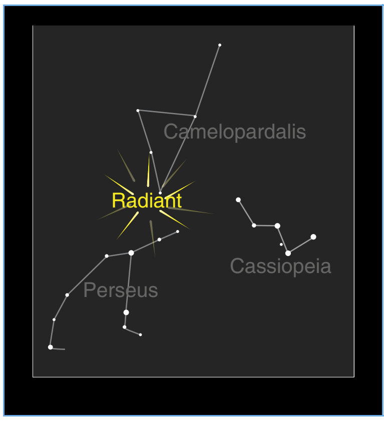
On several occasions, lights, heaters and the Meade LX200 have been left on!

When leaving, please ensure all is secure and all lights, heaters and telescopes are TURNED OFF.

August 2022 - Sky Map



View from Newchurch Isle of Wight UK - 2200hrs - 15 August 2022



The Perseids are a prolific meteor shower associated with the comet Swift–Tuttle. The meteors are called the Perseids because the point from which they appear to hail (called the radiant) lies in the constellation Perseus.

The stream of debris is called the Perseid cloud and stretches along the orbit of the comet Swift–Tuttle. The cloud consists of particles ejected by the comet as it travels on its 133-year orbit. Most of the particles have been part of the cloud for around a thousand years. However, there is also a relatively young filament of dust in the stream that was pulled off the comet in 1865, which can give an early mini-peak the day before the maximum shower. The dimensions of the cloud in the vicinity of the Earth are estimated to be approximately 0.1 astronomical units (AU) across and 0.8 AU along the Earth's orbit, spread out by annual interactions with the Earth's gravity.

August 2022 - Night Sky

Moon Phases

New	First Qtr	Full	Last Qtr
27th	5th	12th	19th

Planets

Mercury

During this month Mercury has a very poor evening apparition at best it sets only about 20 minutes after the Sun, so is not easily visible in the evening sky at our latitude. It is however bright enough in the last few days of the month to be observed during the day using a telescope. Even though its separation from the Sun is about 27 degrees great care must be taken to avoid any possibility of accidentally pointing the telescope at the Sun. This should only be undertaken by experienced observers.

Venus

Venus can be seen very low down in the east-north-east for about an hour before sunrise. It is so bright that it can be seen against the bright pre-dawn sky.

Mars

Mars is now moving away from the Sun and increasing in brightness as it gets higher in the sky. It rises at about midnight and is clearly visible in the east-south-east at about 3AM. A telescope will show a gibbous phase, but surface markings will be difficult to see. Mars is below the Pleiades cluster and to the right of the similarly coloured red giant star Aldebaran the red eye of Taurus the bull.

Jupiter

At around midnight Jupiter can be clearly seen low in the south-eastern sky. It is conspicuously bright, far brighter than any star. Observing through a pair of binoculars the 4 Galilean moon will, depending on their position be easily seen, and a telescope will show the cloud belts and perhaps the great red spot.

Saturn

Saturn is at opposition on the 14th and is visible from sunset until sunrise. Look low in the south at about 1AM, Saturn is the brightest star like object in that part of the sky. A telescope will give good view of the rings though will be somewhat distorted by the atmospheric turbulence that is very noticeable at its time of year.

Uranus

Although Uranus is visible in the morning sky this month, the sky becomes too bright before it has risen high enough for easy observation.

Neptune

Neptune is on the border between the constellations of Aquarius and Pisces. There are no bright stars nearby for guidance to find the faintest of the planets. The finder chart opposite shows its path on the first of each month from August until February next year when it will again become difficult to observe.

Deep Sky

M57 The Ring Nebula
RA 18h 54m Dec 33°2' mag 9.5

This tiny smoke ring in the sky is easily found with a small telescope between Sulafat and Sheliak, the bottom two stars in Lyra. A planetary nebula is the last display of a star similar in size to our Sun. As the star runs out of fuel the outer layers are blown off and the remaining core shrinks to become a white dwarf. The intense ultra violet radiation from the white dwarf causes the surrounding gas to glow as it slowly dissipates into space. In stellar life times this is just a fleeting moment. The ring nebula formed approximately 20,000 years ago.

M29 Open Cluster
RA 20h 24m Dec 38° 32' mag 6.6

Located in the Cygnus arm of the Milky Way this cluster is somewhat over shadowed by the surrounding star fields. It is also dimmed by the dust along our line of sight. Despite all this it is a worthwhile cluster to observe; its brightest members form two opposing arcs that give the impression of a miniature version of the Pleiades.

M24 Sagittarius Star Cloud
RA 18h 16m Dec -18° 43'

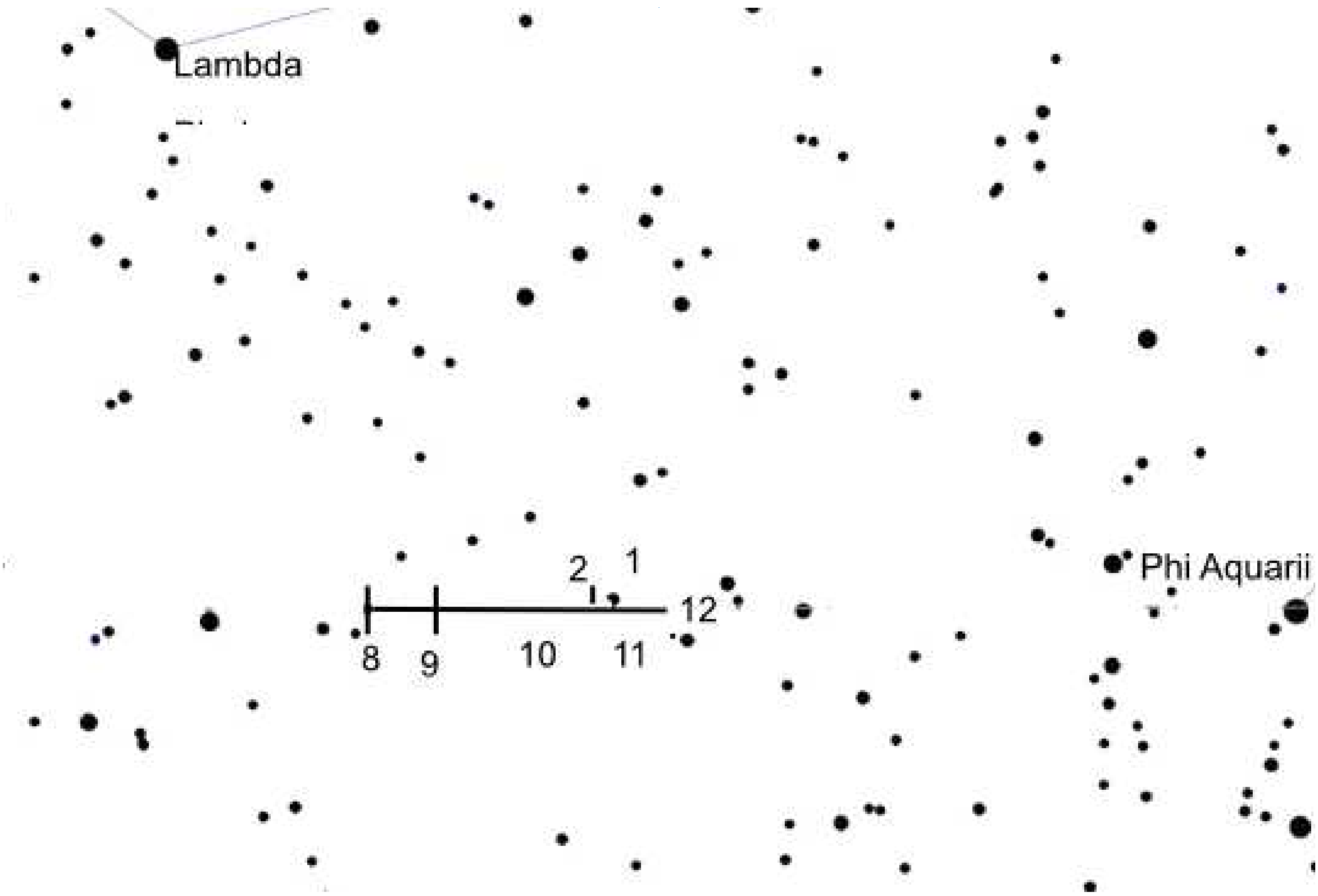
This object is big! Eight times the area of the full moon. It is an object full of objects, open clusters, dark nebulae and even a planetary nebula. Use any optical aid you have, binoculars for wide field views and a telescope for closer examination. This is one of, if not the best star fields in the galaxy; don't miss it.

Meteor Showers

The Perseids meteor shower peaks this month on the night of the 12th/13th, unfortunately coinciding with the full moon that will make visual observation difficult, with only the brightest meteors being visible. The shower is a long lasting one with a sharp peak, so meteors can be seen for most of the month although at somewhat reduced numbers.

Other News

Hubble - NASA has released the latest in its Hubble Focus E-book series titled Strange New Worlds. It describes what has been discovered about some of the strange planets and systems of planets that have been



Finder chart for Neptune from 1st August until 1st February 2023

found orbiting other stars. Together with three other books in the series describing our own solar system, the lives of stars and an overview of the telescope itself can be down loaded from https://www.nasa.gov/content/goddard/hubble-e-books

James Webb and Hubble - A comparison between the latest images from the James Web Space Telescope and the Hubble telescope can be seen at *https://www.webbcompare.com/*. The difference between the images from each instrument is quite striking, it is almost as though the Hubble images have been deliberately subdued to make the JWST images appear more spectacular. The two instruments are of course looking at different wavelengths of light and are compliment one another. In future we will be seeing some more spectacular images from the JSWT and from combinations of images from both telescopes.

Peter Burgess

Please don't forget the AGM on 26th Sept at 19.00hrs

Physicists Have Developed a Method for Predicting the Composition of Dark Matter

A new analysis offers an innovative means to predict 'cosmological signatures' for models of dark matter.

A method for predicting the composition of dark matter has been developed by a team of physicists. Dark matter is invisible matter detected only by its gravitational pull on ordinary matter and whose discovery has been long sought by scientists.

The new work centers on predicting "cosmological signatures" for models of dark matter with a mass between that of the electron and the proton. Previous methods had predicted similar signatures for simpler models of dark matter. This research establishes new ways to find these signatures in more complex models, which experiments continue to search for, the paper's authors note. The paper was published on July 6 in the journal Physical Review Letters.

"Experiments that search for dark matter are not the only way to learn more about this mysterious type of matter," says Cara Giovanetti, a Ph.D. student in New York University's Department of Physics and the lead author of the paper.

"Precision measurements of different parameters of the universe - for example, the amount of helium in the universe, or the temperatures of different particles in the early universe - can also teach us a lot about dark matter," adds Giovanetti, outlining the method described in the Physical Review Letters paper.

In the research, the physicists focused on big bang nucleosynthesis (BBN) - a process by which light forms of matter, such as helium, hydrogen, and lithium, are created. The presence of invisible dark matter affects how each of these elements will form. Also vital to these phenomena is the cosmic microwave background (CMB) - electromagnetic radiation, generated by combining electrons and protons, that remained after the universe's formation. The work was conducted with Hongwan Liu, an NYU postdoctoral fellow, Joshua Ruderman, an associate professor in NYU's Department of Physics, and Princeton physicist Mariangela Lisanti, Giovanetti, and her co-authors.

The team of scientists sought a means to spot the presence of a specific category of dark matter - that with a mass between that of the electron and the proton - by creating models that took into account both BBN and CMB.

"Such dark matter can modify the abundances of certain elements produced in the early universe and leave an imprint in the cosmic microwave background by modifying how quickly the universe expands," Giovanetti explains.

In their research, the team made predictions of cosmological signatures linked to the presence of certain forms of dark matter. These signatures are the result of dark matter changing the temperatures of different particles or altering how fast the universe expands.

Their results showed that dark matter that is too light will lead to different amounts of light elements than what astrophysical observations see.

"Lighter forms of dark matter might make the universe expand so fast that these elements don't have a chance to form," says Giovanetti, outlining one scenario.

"We learn from our analysis that some models of dark matter can't have a mass that's too small, otherwise the universe would look different from the one we observe," she adds.

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https://www.easyfundraising.org.uk/causes/vectisastronomicalsociety/?utm_campaign=raise-more&utm_content=en-n2

Why Jupiter doesn't have rings like Saturn

Because it's bigger, Jupiter ought to have larger, more spectacular rings than Saturn has. But new UC Riverside research shows Jupiter's massive moons prevent that vision from lighting up the night sky.

“It's long bothered me why Jupiter doesn't have even more amazing rings that would put Saturn's to shame,” said UCR astrophysicist Stephen Kane, who led the research.

“If Jupiter did have them, they'd appear even brighter to us, because the planet is so much closer than Saturn.” Kane also had questions about whether Jupiter once had fantastic rings and lost them. It is possible for ring structures to be temporary.

To understand the reason Jupiter currently looks the way it does, Kane and his graduate student Zhexing Li ran a dynamic computer simulation accounting for the orbits of Jupiter's four main moons, as well as the orbit of the planet itself, and information about the time it takes for rings to form. Their results are now online, soon to be published in the Planetary Science journal.

Saturn's rings are largely made of ice, some of which may have come from comets, which are also largely made of ice. If moons are massive enough, their gravity can toss the ice out of a planet's orbit, or change the orbit of the ice enough so that it collides with the moons.

“We found that the Galilean moons of Jupiter, one of which is the largest moon in our solar system, would very quickly destroy any large rings that might form,” Kane said. As a result, it is unlikely that Jupiter had large rings at any point in its past.

“Massive planets form massive moons, which prevents them from having substantial rings,” Kane said.

All four giant planets in our solar system -- Saturn, Neptune, Uranus and also Jupiter -- do in fact have rings. However, both Neptune and Jupiter's rings are so flimsy they're difficult to view with traditional stargazing instruments.

Coincidentally, some of the recent images from the newly commissioned James Webb Space Telescope included pictures of Jupiter, in which the faint rings are visible.

“We didn't know these ephemeral rings existed until the Voyager spacecraft went past because we couldn't see them,” Kane said.

Uranus has rings that are aren't as large but are more substantial than Saturn's. Going forward, Kane intends to run simulations of the conditions on Uranus to see what the lifetime of that planet's rings might be.

Some astronomers believe Uranus is tipped over on its side as the result of a collision the planet had with another celestial body. Its rings could be the remains of that impact.

Beyond their beauty, rings help astronomers understand the history of a planet, because they offer evidence of collisions with moons or comets that may have happened in the past. The shape and size of the rings, as well as the composition of the material, offers an indication about the type of event that formed them.

“For us astronomers, they are the blood spatter on the walls of a crime scene. When we look at the rings of giant planets, it's evidence something catastrophic happened to put that material there,” Kane said.

From: https://www.sciencedaily.com/

Giant Lovell Radio Telescope to Become Space Light Show

20-23 JULY 2023
JODRELL BANK OBSERVATORY
CHESHIRE · EARTH

The UK's largest radio telescope - the Lovell telescope at Jodrell Bank in Cheshire - is being turned into a light and sound show.

For the first time since 2019, at the Bluedot festival, the giant radio telescope will take centre stage.

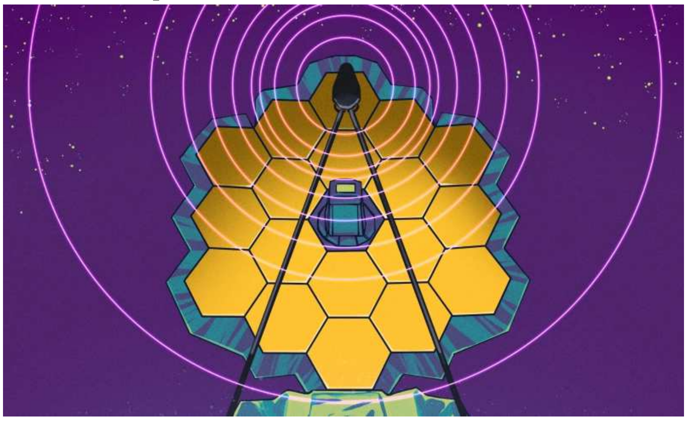
Images from space, including some stunning pictures from Nasa's James Webb Space Telescope will be beamed on to its 249ft (76m) dish.

“We'll use that dish as a huge film screen,” said Prof Teresa Anderson.

The astrophysicist and director of the Jodrell Bank Discovery Centre explained: “We'll project on to it some of the latest data from the Sun and beautiful images of the Moon.”

More info at: https://www.bbc.com/news/science-environment-62269520

How Does the James Webb Telescope Phone Home?



When it comes to an engineering marvel like the James Webb Space Telescope, the technology involved is so specialized that there's precious little the average person can truly relate to. We're talking about an infrared observatory that cost $10 billion to build and operates at a temperature of 50 K (-223 °C; -370 °F), 1.5 million kilometers (930,000 mi) from Earth — you wouldn't exactly expect it to share any parts with your run-of-the-mill laptop.

But it would be a lot easier for the public to understand if it did. So it's really no surprise that this week we saw several tech sites running headlines about the "tiny solid state drive" inside the James Webb Space Telescope. They marvelled at the observatory's ability to deliver such incredible images with only 68 gigabytes of onboard storage, a figure below what you'd expect to see on a mid-tier smartphone these days. Focusing on the solid state drive (SSD) and its relatively meager capacity gave these articles a touchstone that was easy to grasp by a mainstream audience. Even if it was a flawed comparison, readers came away with a fun fact for the water cooler — "My computer's got a bigger drive than the James Webb."

Of course, we know that NASA didn't hit up eBay for an outdated Samsung EVO SSD to slap into their next-generation space observatory. The reality is that the solid state drive, known officially as the Solid State Recorder (SSR), was custom built to meet the exact requirements of the JWST's mission; just like every other component on the spacecraft. Likewise, its somewhat unusual 68 GB capacity isn't just some arbitrary number, it was precisely calculated given the needs of the scientific instruments onboard.

With so much buzz about the James Webb Space Telescope's storage capacity, or lack thereof, in the news, it seemed like an excellent time to dive a bit deeper into this particular subsystem of the observatory. How is the SSR utilized, how did engineers land on that specific capacity, and how does its design compare to previous space telescopes such as the Hubble?

High Speed in Deep Space

The communication needs of the James Webb Space Telescope provided engineers with a particularly daunting challenge. To accomplish its scientific goals the spacecraft must be located far away from the Earth, but at the same time, a considerable amount of bandwidth is required to return all of the collected data in a timely manner.

To facilitate this data transfer, the JWST has a 0.6 meter (2 foot) diameter Ka-band high-gain antenna (HGA) on an articulated mount that allows it to be pointed back to Earth regardless of the observatory's current orientation in space. This Ka-band link provides a theoretical maximum bandwidth of 3.5 MBps through NASA's Deep Space Network (DSN), though the actual achievable data rate is dependent on many factors.

Unfortunately this high-speed link back to Earth isn't always available, as the DSN needs to juggle communications with many far-flung spacecraft. With the network's current utilization, the JWST has been allocated two four-hour windows each day for data transmission. On paper, that means the spacecraft should be able to transmit just over 100 GB of data back to Earth in a 24 hour period, but in practice there are other issues to consider.

For one thing, the high-gain antenna can't constantly track the Earth, as its movement produces slight vibrations that could ruin delicate observations. Instead, it's moved every 2.7 hours to keep the planet within the beam width of the antenna. Observations are to be scheduled around this whenever possible, but inevitably, a conflict will eventually arise. Either high-speed data transmission will have to be cut short, or long-duration observations will need to be put on pause while the antenna is realigned. Mission planners will have to carefully weigh their options, with the deciding factor likely to be the scientific importance of the observation in question.

There's also downtime to consider, on both ends of the link. The DSN could temporarily be unable to receive transmissions, or there could be an issue aboard the spacecraft that prevents it from making its regularly scheduled broadcast. Between the logistical challenges associated with the observatory's standard downlink and the possibility of unforeseen communication delays, the only way the James Webb could ever hope to make round-the-clock observations is with a sizable onboard data cache.

Flight Tested Technology

In the context of personal computing, solid state drives are a relatively new development. But NASA has been well aware of the advantages, namely lighter weight and a lack of moving parts, for decades. The space agency isn't known for fielding untested concepts on flagship missions, and this is no different. They've been using a similar approach on the Hubble Space Telescope since 1999, when astronauts on the third servicing mission replaced the spacecraft's original tape-based storage with a 1.5 GB SSR.

Naturally the lower capacity of Hubble's SSR is due, at least in part, to the era. But even still, this was a considerable upgrade, as the tape recorders the SSR replaced could only hold around 150 MB. Remember that the resolution of the images captured by Hubble are considerably lower than that of the JWST, but that communications with spacecraft in Earth orbit are naturally far more reliable than those in deep space.

Store and Forward

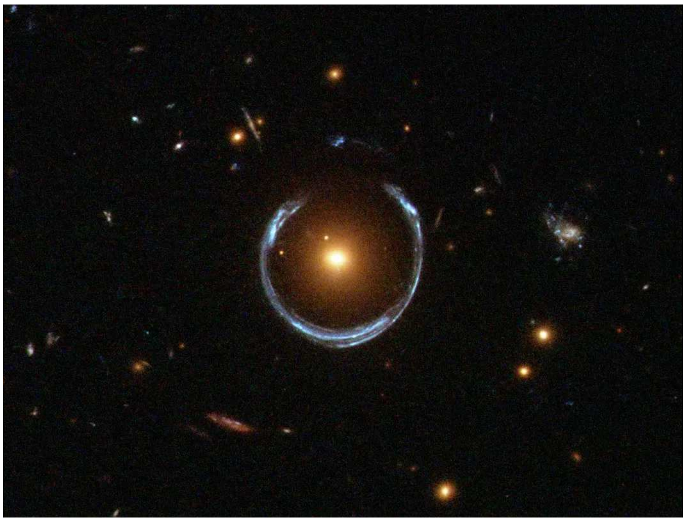
All told, NASA estimates the James Webb should be able to transmit a little over 28 GB through the DSN during each of its twice-daily windows. To provide a full 24 hour buffer, the spacecraft therefore needs about 60 GB of onboard storage. So why is the SSR 68 GB? Partly due to the fact that some of the space is reserved for the observatory's own use. But also because, as explained by flight systems engineer Alex Hunter to IEEE Spectrum, the extra capacity gives the system some breathing room as wear and radiation whittle away at the SSR's flash memory over the next decade.

It might not seem like 24 hours is much of a safety net, but there's several provisos attached to that number. Depending on which scientific instruments are actually being used on the James Webb, the actual amount of data generated each day could be considerably lower. If high-speed communications are hindered, ground controllers would likely put the more data-intensive observations on hold until the issue is resolved. If necessary, NASA could also allocate extra DSN time to work through the backlog. In short, there are enough contingencies in place that the capacity of the SSR should never become a problem.

So while you could certainly find a bigger solid state drive in a mid-range Chromebook than the one NASA recently sent on a decade-long mission aboard the James Webb Space Telescope — careful planning and a healthy dose of the best engineering that money can buy means that size isn't everything.

Links etc at:
https://hackaday.com/2022/07/25/how-does-the-james-webb-telescope-phone-home/

5000 Exoplanets



A Hubble image of a red galaxy acting as a gravitational lens for a more distant blue galaxy, bending its light into an arc. Exoplanets can be detected via a similar effect, gravitational microlensing, when a foreground star and its orbiting planet fortuitously pass across a background star in the sky, creating bright flashes. Astronomers have spotted a new microlensed, Jupiter-sized exoplanet around an M dwarf star, and use the result to help decide between competing planet formation scenarios.
Credit: ESA/Hubble and NAS

Over 5,000 exoplanets have been detected to date, with more than 90% of them found by using the transit or radial velocity techniques. Of the other 10%, 105 were found using the microlensing method which takes advantage of the fact that the path of a light beam is bent by the presence of a massive body. The gravitational force of the body acts like a lens (a "gravitational lens") to distort the image of an object seen behind it. When a massive object fortuitously passes in front of a star, it acts as a gravitational lens and thus its motion across the sky causes the background star to appear to brighten briefly. When the foreground object is a star hosting a planet, both bodies can produce brightening events as they pass in front of the star, and the flashes as seen from Earth can be modeled to determine their masses and separation.

Two significant advantages are offered by the microlensing method over more common exoplanet detection techniques. First, the brightness of the microlensing effect does not depend on the brightness of the moving body, only on its mass, which makes it possible to spot faint, low-mass M dwarf stars. The second advantage is that the microlensing planet may orbit its star at a large distance, even many astronomical units. (Since normal exoplanet techniques, like transiting, require multiple detections over many orbital periods, exoplanets with large orbits take years to complete their cycle and so far the vast majority of all measured exoplanets have orbits smaller than one astronomical unit.) As a result of their large orbits, the detected giant planets around microlensing host stars are usually far enough away to reside beyond the "snow line," the distance at which surface water would freeze.

Harvard-Smithsonian Center for Astrophysics (CfA) astronomer Jennifer Yee collaborates with a team of astronomers from the OGLE project (Optical Gravitational Lensing Experiment), which discovered the microlensing event OGLE-2017-BLG-1049. The analysis was led by her colleagues in the Korea Microlensing Telescope Network.

They modeled the brightening events using some probable assumptions, and concluded that the host star is an M dwarf with a mass of about 0.55 solar masses; the planet has a mass of about 5.5 Jupiter-masses and orbits at a distance of 3.9 astronomical units. These results have direct implications for models of planet formation. Fifty-four of the known microlensed exoplanets are giants around M dwarfs, like this new one, suggesting that planets are common around M dwarfs.

In the core accretion model of planet formation, however, in which planets gradually assemble from smaller rocks, very few planets are expected to be found around M dwarf stars. The result appears instead to support the alternative disk instability model in which a rotating disk fragments into clumps that form planets, and it predicts that many planets exist around M dwarf stars.

Link: https://scitechdaily.com/a-giant-planet-microlensing-event/

James Webb, Halley's Comet might be set for cosmic dust-up

The James Webb Space Telescope is predicted to pass through Halley's Comet's debris trail next year, meaning that particles could further endanger its sensitive primary mirror.

JWST's mirror is exposed to the vacuum of space, and while that means it produces images with far more clarity than Hubble, it also has nothing to shield it from sand grain-sized debris traveling at 10km/second, or 6.2 miles/second (over 22,300mph).

Small debris can cause serious damage, such as the May impact on Webb's mirror that caused irreparable harm, but which NASA was able to correct for.

Halley's Comet itself won't be back in the inner solar system until 2061, but the bright tail trailing out behind it is filled with dust, debris and ice shed by the comet. It's that debris field that JWST is predicted to enter in 2023 and 2024.

Webb wasn't built to last

According to Nature, meteor shower dust like that left behind by Halley only constitutes around 5 percent of the impact risk to Webb, while the rest is from random hits from stray dust. Scientists have long planned for such hits during Webb's lifetime, but May's unexpected impact has had scientists re-evaluating the potential for serious damage and developing custom meteor shower forecasts at Lagrange point 2, where Webb sits in space.

With those forecasts, the space telescope's operators can reposition the telescope to avoid incoming dust, but such forecasts still leave Webb exposed to unpredictable hits from single micrometeoroids, as was the case in May.

Hubble, by contrast, which sits in low earth orbit and is encased within a tube, is still operating after more than 30 years.

Webb gets around Hubble's primary limitation of having a limited observational wavelength in a couple of ways: It doesn't lock its mirror in a tube, and it sits far enough from the Sun that it can offset heating that limits wavelengths. While those elements make Webb a better observer of the cosmic condition, it also means it's not serviceable once deployed and is exposed to lots of potential damage.

NASA said the minimum baseline for JWST's mission duration is five years, with the agency hoping to get a decade out of the telescope. The fuel in JWST is enough to keep it in position and transmitting data for longer than a decade, NASA said, but that's if a grain of sand doesn't turn Webb into a $10 billion lesson in protecting sensitive equipment

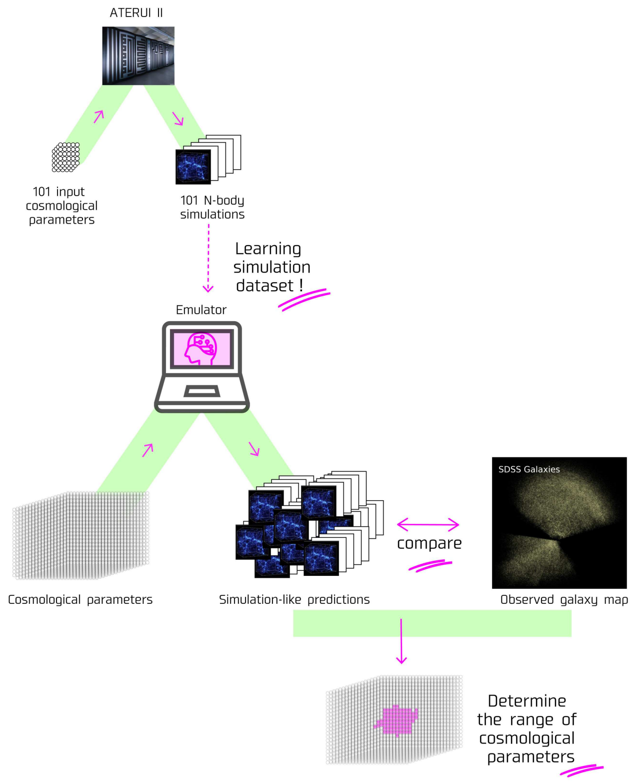
More at: https://www.theregister.com/2022/07/26/james_webb_and_halleys_comet/

July Meeting Download

In case anyone missed my recent email, here is the link to download or stream a copy of last month's Zoom meeting regarding the James Webb Telescope:

http://www.wightastronomy.org/Files/James Webb Telescope.mp4

An AI-assisted Analysis of Three-Dimensional Galaxy Distribution in our Universe



Flow chart of how the emulator developed by the research team works. Credit: Kavli IPMU, NAOJ

By applying a machine-learning technique, a neural network method, to gigantic amounts of simulation data about the formation of cosmic structures in the universe, a team of researchers has developed a very fast and highly efficient software program that can make theoretical predictions about structure formation. By comparing model predictions to actual observational datasets, the team succeeded in accurately measuring cosmological parameters, reports a study in Physical Review D.

When the biggest galaxy survey to date in the world, the Sloan Digital Sky Survey (SDSS), created a three-dimensional map of the universe via the observed distribution of galaxies, it became clear that galaxies had certain characteristics. Some would clump together, or spread out in filaments, and in some places there were voids where no galaxies existed at all. All these show galaxies did not evolve in a uniform way, they formed as a result of their local environment. In general, researchers agree this non-uniform distribution of galaxies is because of the effects of gravity caused by the distribution of "invisible" dark matter, the mysterious matter that no one has yet directly observed.

By studying the data in the three-dimensional map of galaxies in detail, researchers could uncover the fundamental quantities such as the amount of dark matter in the universe. In most recent years, N-body simulations have been widely used in studies recreating the formation of cosmic structures in the universe. These simulations mimic the initial inhomogeneities at high redshifts by a large number of N-body particles that effectively represent dark matter particles, and then simulate how dark matter distribution evolves over time, by computing gravitational pulling forces between particles in an expanding universe. However, the simulations are usually expensive, taking tens of hours to complete on a supercomputer, even for one cosmological model.

A team of researchers, led by former Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) Project Researcher Yosuke Kobayashi (currently Postdoctoral Research Associate at The University of Arizona), and including Kavli IPMU Professor Masahiro Takada and Kavli IPMU Visiting Scientists Takahiro Nishimichi and Hironao Miyatake, combined machine learning with numerical simulation data by the supercomputer "ATERUI II" at the National Astronomical Observatory of Japan (NAOJ) to generate theoretical calculations of the power spectrum, the most fundamental quantity measured from galaxy surveys which tells researchers statistically how galaxies are distributed in the universe.

Usually, several millions of N-body simulations would need to be run, but Kobayashi's team were able to use machine learning to teach their program to calculate the power spectrum at the same level of accuracy as a simulation, even for a cosmological model for which the simulation had not yet been run. This technology is called an Emulator, and is already being used in computer science fields outside of astronomy.

"By combining machine learning with numerical simulations, which cost a lot, we have been able to analyze data from astronomical observations with high precision. These emulators have been used in cosmology studies before, but hardly anyone has been able to take into account the numerous other effects, which would compromise cosmological parameter results using real galaxy survey data. Our emulator does and has been able to analyze real observation data. This study has opened up a new frontier to large-scale structural data analysis," said the lead author Kobayashi.

However, to apply the emulator to actual galaxy survey data, the team had to take into account "galaxy bias" uncertainty, an uncertainty taking into consideration that researchers cannot accurately predict where galaxies form in the universe because of their complicated physics inherent in galaxy formation.

More at: https://phys.org/

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LINKS, COMMENTS AND OBSERVATIONS

See a Galactic Collision in Stunning Detail

Wham! The galaxies NGC 4568 (bottom) and NGC 4567 (top) collide in this new image from the Gemini North telescope in Hawaii.

The two galaxies in the image above are actively colliding. You might think this stunning new image is from the space-based Webb telescope. But in fact, it's courtesy of the Gemini North telescope in Hawaii. We're witnessing two galaxies beginning to merge together due to their mutual gravitational pull. Over hundreds of millions of years, the galaxies will continue to mesh together, until they form one new galaxy. That won't happen for about another 500 million years, however.

A Galactic Collision Millions of Light-Years Away

The Gemini North telescope captured the two galaxies – NGC 4567 and NGC 4568 – just as they are beginning their merge. There's no danger to our own galaxy as this cosmic collision is far away from us at about 60 million light-years. The galaxies are in the direction of the constellation Virgo.

NGC 4568 is the larger-appearing galaxy on the bottom, while NGC 4567 looks like it is dive-bombing its companion. At this point, both galaxies retain their spiral shapes. But eventually, they will merge to form a single elliptical galaxy. Currently, the centers of the two galaxies are about 20,000 light-years apart.

More and hi-res pics at: https://earthsky.org/space/galactic-collision-ngc-4568-and-4567/

At The Observatory

1. **Please bring a torch.**
2. **Make sure you close and lock the car park gate if you are the last to leave.**

Articles Needed

NZ needs relevant content. Contact details on page 1.

Strange Facts

On Mercury a day is twice as long as a year
Technically, one Mercurian day lasts 59 Earth days, while a year lasts 88. However, due to Mercury's very eccentric orbit and alignment with the Sun, the length of time from sunrise to sunrise, a 'solar day', is equal to 176 Earth days — twice as long as a Mercurian year.

Gamma-ray bursts can release more energy in 10 seconds than our Sun will in its entire life
Nothing rivals the power unleashed during a gamma-ray burst, a brief but incredibly intense flash of high-energy radiation. There are many types of GRB: some are thought to form when a massive star implodes; others when two neutron stars merge together.

The Moon is lemon-shaped
Despite its appearance in the night sky, our moon is nowhere near round, it is shaped like a lemon, with flattened poles and bulges on the near and far side around its equator. This shape is thought to have formed during interactions with Earth soon after its formation.