New Zenith

The Monthly Newsletter of the Vectis Astronomical Society

Vol 30 Issue 5 — June 2022 *When Printed, this Newsletter costs VAS at least £1*

Society News

Sorry, it's been another busy month for me at work so NZ is again completed a little later than I would have liked it to be. Hopefully I'll manage to get things back to normal next month!

Observatory

We have been much quieter than expected at the usual Thursday evening meetings with very few members turning up. Thanks goodness we've had some visitors and a few clear skies.

The dome is our biggest concern at the moment as it has a few small leaks and is really beginning to show its age. I think we are going to have to make some pretty large changes as the original manufacturer of the dome isn't replying to my numerous emails. I suspect they've moved on to more advanced systems and as our equipment is at least 25 years old I guess we can't really expect a ready supply of spares.

The current thinking is to remove the existing dome, replace it with something slightly smaller in a separate but connected dome at ground level. This will mean we have single level access to all of our equipment, provide a larger classroom/meeting space and also improve the long-standing problems of "pillar" vibration.

Assuming of course that we can obtain grants, the plan is to "flatten" the roof structure and re-cover it, making space for roof mounted radio-astronomy antennae. The new smaller, lower level, dome will contain a telescope reserved for astrophotography.

At the moment this is all wishful thinking as there are a few things to consider:

1. The lease on the VAS building will need to be amended and agreed (this is nearly due anyway)

2. We can obtain the required grants to pay for things

3. We have VAS members' support

Feel free to make your feelings known...........

Brian Curd

VAS Website: wightastronomy.org

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

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St John's Crescent
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
24 Jun	Observing the Moon	Richard Flux
22 Jul	James Webb Space Telescope	Dr Stephen Wilkins
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

President	Barry Bates president@wightastronomy.org
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Others	Dudley Johnson

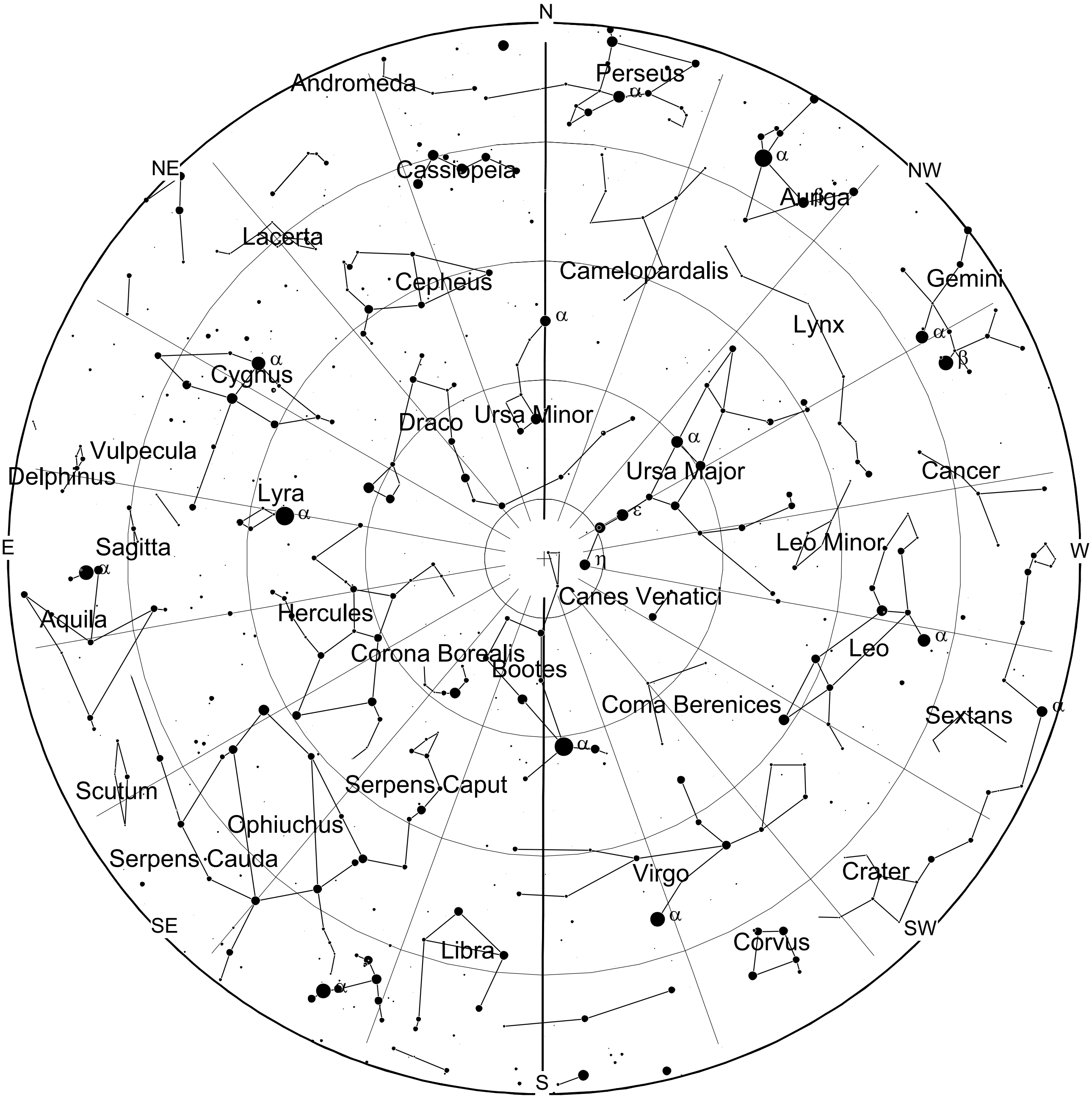
Important

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.

June 2022 - Sky Map



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

The Cat's Eye Nebula (also known as NGC 6543 and Caldwell 6) is a planetary nebula in the northern constellation of Draco, discovered by William Herschel on February 15, 1786. It was the first planetary nebula whose spectrum was investigated by the English amateur astronomer William Huggins, demonstrating that planetary nebulae were gaseous and not stellar in nature. Structurally, the object has had high-resolution images by the Hubble Space Telescope revealing knots, jets, bubbles and complex arcs, being illuminated by the central hot planetary nebula nucleus (PNN). It is a well-studied object that has been observed from radio to X-ray wavelengths.

June 2022 - Night Sky

Summer Solstice

The Summer Solstice, the point at which the Sun reaches its most northerly position in the sky occurs on June 21 at 09:14 UTC. After this time its starts is journey back towards the south and the hours of daylight start to shorten.

Moon Phases

New	First Qtr	Full	Last Qtr
29th	7th	14th	21st
●	◐	○	◑

Planets

Mercury

Towards the end of June and into the first week of July, Mercury makes a rather poor apparition in the morning sky. It is at greatest western elongation on the 16th, but only rises 1 hr before the Sun. At this time it is not very bright, about mag 0.6 about the same as the brighter stars, it will be quite difficult to see against the pre-dawn sky. Using a pair of binoculars follow a line from the much brighter Venus towards the point where the Sun will rise to help locate this elusive little world. On the 27th Mercury can be found about 3º below the thin crescent moon.

The table shows the position of Mercury for the complete apparition.

Azimuth & Altitude of Mercury at 04:30 BST					
Date	**Az**	**Alt**	**Date**	**Az**	**Al**
16 Jun	68	4	28 Jun	62	5
18	67	4	30	61	5
20	67	5	2 Jul	59	4
22	66	5	4	57	4
24	65	5	6	55	3
26	64	5	8	53	2

Venus

Venus is easily seen in the pre-dawn sky, it is very bright and easily seen low down in the east north-east. On the 26th the thin crescent moon is about 2º above Venus making a good photo opportunity if the sky is clear.

Mars

On the 29th of May Mars will be in very close conjunction with the much brighter Jupiter, and will remain close by for a few days after. At the beginning of the month Mars rises at about 02:45 and very close to Jupiter, and by the end of the month it rises at about 01:30 and is about a third of the way to wards Venus. It is about magnitude 0.5 making it comparable to the brightest stars

Jupiter

From about 3AM at the beginning of the month and 2AM at the end of the month look low in the east south-east to see Jupiter. Brighter than any star in that part of the sky it will be easy to see against the brightening pre dawn sky.

Saturn

Look low in the south east during the darkest hours of the night to see Saturn. It is deep in the southern sky and is not particularly well placed for observation from our latitude.

Uranus & Neptune

Both the outer planets are too close to the Sun and are not easily visible until later in the year.

Deep Sky

M4 Globular Cluster
RA 16h 24m Dec -26° 33' mag 7.5

At about 7200 light years this 10,000 million year old cluster may be the closest globular cluster to our solar system. This core of this cluster is rather looser than most globulars with a distinct chain of stars running across its centre.

M80 Globular Cluster
RA 16h 17m Dec -22° 59' mag 8.5

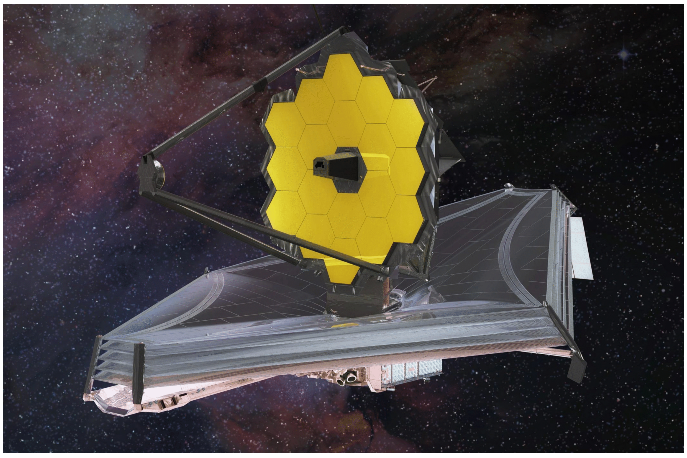
In contrast to M4 this cluster is a much smaller with a very condensed core. In 1880 a nova was observed here, one of only two novae ever seen in a globular cluster.

M13 The Hercules Cluster
RA 16h 42' Dec 36° 26' mag 5.8

On a dark night the Hercules globular can be seen with the naked eye as a fuzzy star part way down the right hand side of the keystone asterism. This is the brightest and many would argue the best globular visible from the northern hemisphere. It lies some 25,000 light years away from us, relatively close by globular cluster standards. As with all globular clusters the view improves with increasing aperture used to observe it. The view is of a sugar coated ball frozen in time, and surrounded by a flurry of sugar grains.

Peter Burgess

James Webb Space Telescope



In addition to looking at distant stars, galaxies, and exoplanets, the NASA/ESA/CSA James Webb space telescope will investigate our solar system. Credit: Northrup Grumman

The James Webb Space Telescope is the next great space science observatory, designed to answer outstanding questions about the Universe and to make breakthrough discoveries in all fields of astronomy.

Launched in December 2021 on an Ariane 5 rocket from Europe's Spaceport in French Guiana, Webb is designed and built to offer scientists the capabilities needed to push the frontiers of knowledge in many areas of astronomy. This includes research on our own Solar System, the formation of stars and planets (including planets outside our Solar System - exoplanets), and how galaxies are formed and evolve, in ways never before possible.

The James Webb Space Telescope is an international project led by NASA in partnership with ESA and the Canadian Space Agency. In addition to providing the Ariane 5 rocket and launch services to bring the telescope into space, ESA is also providing instruments for the telescope as well as scientists who will support the mission's operations.

This includes the Near Infrared Spectrograph (NIRSpec) instrument, the workhorse near-infrared spectrograph onboard Webb, which is provided entirely by ESA. The primary goal of NIRSpec is to enable large spectroscopic surveys of astronomical objects such as stars or distant galaxies. This is made possible by its powerful multi-object spectroscopy mode.

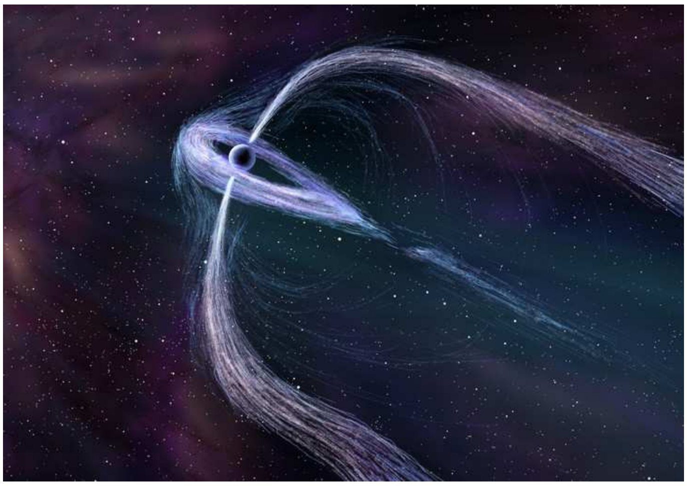
ESA is also supporting the provision of the Mid-Infrared Instrument (MIRI) instrument, the only instrument on the telescope that is capable of operating at mid-infrared wavelengths. It will support the whole range of Webb's science goals, from observing our own Solar System and other planetary systems, to studying the early Universe. MIRI is a versatile instrument offering a wide set of modes.

Webb will observe the Universe at wavelengths longer than visible light, namely in the near-infrared and mid-infrared. Compared to Hubble's 2.4-meter (8-foot) primary mirror, Webb is equipped with a primary mirror that spans 6.5 meters (21 feet) in diameter. Another key difference between Hubble and Webb is where they are located to study the cosmos. While Hubble is positioned in Earth orbit at an altitude of approximately 570 kilometers (350 miles), Webb is orbiting a point in space beyond the orbit of the Moon known as a Lagrange point, roughly 1.5 million kilometers (930,000 miles) from Earth.

More with Links at: https://scitechdaily.com/

Seeing Inside a Cosmic Superaccelerator

Exploring a celestial particle accelerator in the Eel Nebula that surrounds a distant pulsar



This artist's representation shows a pulsar wind nebula around another pulsar, named Geminga. Pulsar wind nebulae may be the cosmic sites of particle accelerators. Credit: Nahks TrEhnl

Take a coin out of your pocket and flip it. That coin-flip carries a peta-electron-volt (PeV) of energy. Now imagine a particle a million billion times smaller than your coin, far beyond the range of even the most powerful microscope - and it's flitting by with that same amount of energy. That one particle surpasses by a thousandfold the energy that humanity's most sophisticated particle accelerators can generate.

Yet the universe has no shortage of such exceedingly energetic particles. They slam into Earth's atmosphere all the time. But while astronomers have long known these potent particles exist, they've struggled to understand how they come to be. Only recently has data begun to shed light on this phenomenon.

A Twisted Path

The trouble is, PeV particles are generally charged, whether they be protons or electrons. As such, they're susceptible to the manipulations of magnetic fields, their paths bending this way and that as they pass through the galaxy. Tracing a single particle back to its source is nigh impossible.

But the processes that make energetic particles also makes gamma rays. And gamma rays, being chargeless photons, are not so easily led astray by the galaxy's swirling magnetic field. These photons are thus the messengers that can tell astronomers where particles are being accelerated - and how.

Two facilities have come online in recent years to give astronomers access to the highest-energy gamma rays: the Large High Altitude Air Shower Observatory (LHAASO) in Tibet and the High-Altitude Water Cherenkov Observatory (HAWC) in Mexico. Their data has enabled astronomers to identify roughly a dozen possible cosmic particle accelerators, known as Pevatrons.

The Eel Nebula

One of these Pevatron candidates is the Eel Nebula, 11,400 light-years away in the constellation Scutum. In this nebula, a cloud of charged particles surrounds a pulsar as it speeds through space, leading to its distinct snakish shape.

Using observations not just of gamma rays but also X-rays and radio waves to describe the particle cloud, Daniel Burgess (Columbia Astrophysics Laboratory) and team put together a computer model that describes the current state of the pulsar, the plasma around it, and their evolution over time. In a study to appear in Astrophysical Journal, they show that this particular Pevatron is accelerating electrons to PeV energies.

"This is one of the first unambiguously identified [electron-accelerating] PeVatron candidates," says Henrike Fleischhack (Catholic University of America). "The follow-up observations and detailed modeling presented here. . . can serve as a blueprint for the study and identification of other PeVatron candidates."

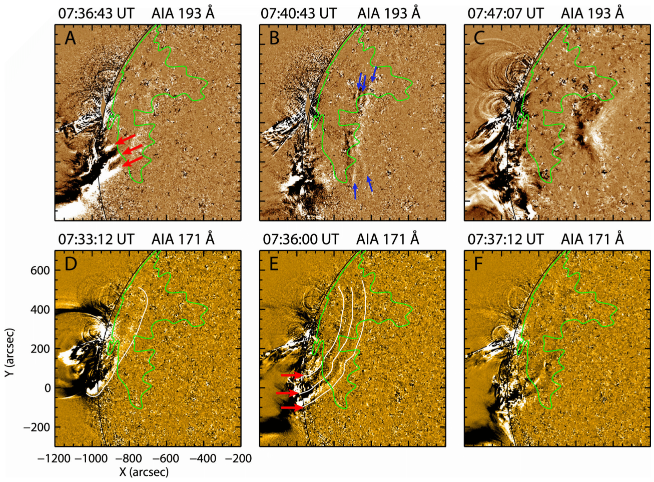
Indeed, team member Kaya Mori (also at Columbia Astrophysics Laboratory) confirms that the team is working on applying the same technique to multiple other pulsar clouds, including two nebulae evocatively named Dragonfly and Boomerang. Other teams are investigating alternative Pevatrons, such as the shocked plasma bubbles cast out by supernova explosions.

While the Eel Nebula is a clear candidate source of PeV electrons, Fleischhack points out that the energetic particles observed at Earth consist of not only electrons but protons. And so far, most of the other candidate Pevatrons have been found to only accelerate electrons.

"The question remains," Fleischhack says: "Where are the [proton-accelerating] PeVatrons that we know must be out there?"

More at: https://skyandtelescope.org/

Researchers find solid evidence of coronal waves excited by flares



Credit: The Astrophysical Journal Letters (2022). DOI: 10.3847/2041-8213/ac651e

Researchers led by Dr. Zhou Xinping from Yunnan Observatories of the Chinese Academy of Sciences and their collaborators have found solid evidence of coronal waves excited by flares.

Their study was published in The Astrophysical Journal Letters. The study result implies that the broad extreme-ultraviolet (EUV) wave train, including multiple wave fronts, should be driven by some nonlinear energy release processes in the accompanying flare.

It is generally believed that the single, diffused, and bright disturbance is a fast-mode piston shock and bow shock driven by a coronal mass ejection (CME)'s expansion.

Although this scenario can explain many observational features of the large-scale coronal waves, it is hard to distinguish whether a particular EUV wave is driven by a CME or ignited by a flare because the CME acceleration phase generally synchronizes with the flare's impulsive phase.

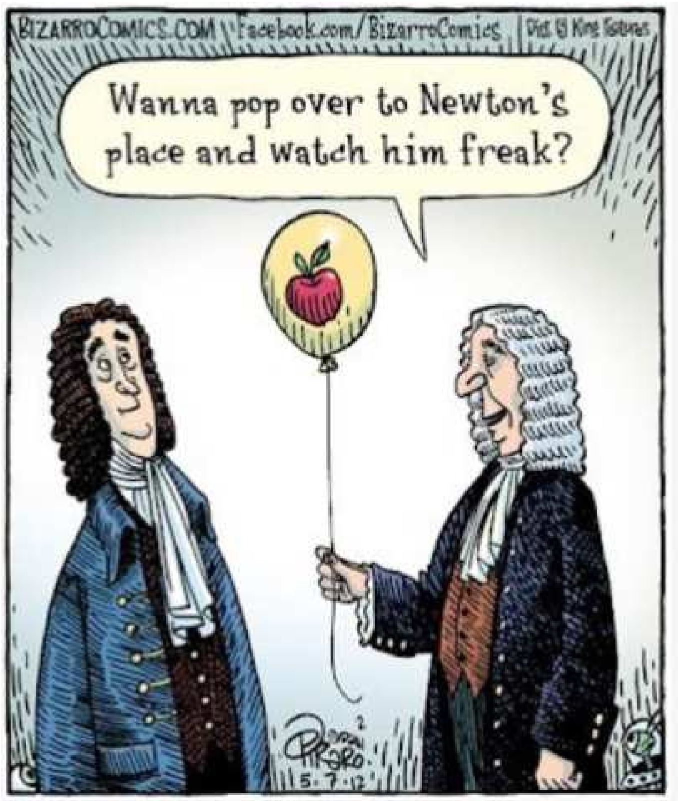
Using the high spatio-temporal imaging observations from Solar Dynamics Observatory/Atmospheric Imaging Assembly (SDO/AIA), Zhou Xinping and his collaborators found that a broad EUV wave train composed multiple large-scale wave fronts. This wave train is difficult to explain using the CME lateral expansion theory.

They found that the physical parameters of the wave train, such as speed, amplitude, and energy flux were consistent with the classical large-scale EUV wave.

Meanwhile, the analysis result showed that the CME acceleration phase's beginning time was behind the first wave front's appearance. In contrast, the beginning time of the wave train was slightly behind the onset of the accompanying flare. Combined with the above observational fact and the common period between the accompanying flare and wave train, the researchers proposed that the flare rather than the CME triggered the wave train.

This study may provide a reliable case for supporting the flare-driven mechanism of the EUV waves. It also provides the first evidence of the interference effect of EUV waves, suggesting the true wave nature of the observed disturbance.

More at: https://phys.org/



I was watching a really good documentary about Quantum physics the other day

But I decided to stop watching in case I affected the outcome

Gresham College Lectures

Gresham College have run free public lectures since 1597.

I'd like to invite your members to some free, Online lectures by Sir Roger Penrose and Professor Katherine Blundell in June 2022. You can register for any of these lectures to watch online via the links below.

Lucia Graves *www.gresham.ac.uk*

Life in the Universe

Katherine Blundell, Gresham Professor of Astronomy, Gresham College

6pm, Weds 1 June at this link:

https://www.gresham.ac.uk/whats-on/life-universe

How can life form in the Universe, and what are the necessary ingredients for habitability so that planets can sustain life? Can we expect life elsewhere in the solar system, or on exo-planets?

This lecture offers a broader perspective from astrobiology, astrochemistry, and astrophysics on the habitability or otherwise of other planets beyond Planet Earth.

The Journey from Black-Hole Singularities to a Cyclic Cosmology

Sir Roger Penrose

6pm, Thursday, 9 June 2022 at this link:

https://www.gresham.ac.uk/whats-on/thomas-gresham-22

The '*singularity theorems*' of the 1960s demonstrated that large enough celestial bodies, or collections of such bodies, would, collapse gravitationally, to 'singularities', where the equations and assumptions of Einstein's general relativity cannot be mathematically continued. Such singularities are expected to lie deep within what we now call black holes. Similar arguments (largely by Stephen Hawking) apply also to the 'Big-Bang' picture of the origin of the universe, but whose singularity has a profound structural difference, resulting in the 2nd law of thermodynamics, whereby 'randomness' in the universe increases with time. It is hard to see how any ordinary procedures of 'œquantization' of Einstein's theory can resolve this contrasting singularity conundrum.

Listen to our podcast: *https://podcast.gresham.ac.uk*

Newsletter *https://www.gresham.ac.uk/newsletter/*

NASA's Ingenuity Mars Helicopter Captures Video of Record Flight

The Ingenuity Mars Helicopter's black-and-white navigation camera has provided dramatic video of its record-breaking 25th flight, which took place on April 8. Covering a distance of 2,310 feet (704 meters) at a speed of 12 mph (5.5 meters per second), it was the Red Planet rotorcraft's longest and fastest flight to date. (Ingenuity is currently preparing for its 29th flight.)

"For our record-breaking flight, Ingenuity's downward-looking navigation camera provided us with a breathtaking sense of what it would feel like gliding 33 feet above the surface of Mars at 12 miles per hour," said Ingenuity team lead Teddy Tzanetos of NASA's Jet Propulsion Laboratory in Southern California.

The first frame of the video clip begins about one second into the flight. After reaching an altitude of 33 feet (10 meters), the helicopter heads southwest, accelerating to its maximum speed in less than three seconds. The rotorcraft first flies over a group of sand ripples then, about halfway through the video, several rock fields. Finally, relatively flat and featureless terrain appears below, providing a good landing spot. The video of the 161.3-second flight was speeded up approximately five times, reducing it to less than 35 seconds.

The navigation camera has been programmed to deactivate whenever the rotorcraft is within 3 feet (1 meter) of the surface. This helps ensure any dust kicked up during takeoff and landing won't interfere with the navigation system as it tracks features on the ground.

Ingenuity's flights are autonomous. "Pilots" at JPL plan them and send commands to the Perseverance Mars rover, which then relays those commands to the helicopter. During a flight, onboard sensors – the navigation camera, an inertial measurement unit, and a laser range finder – provide real-time data to Ingenuity's navigation processor and main flight computer, which guide the helicopter in flight. This enables Ingenuity to react to the landscape while carrying out its commands.

Mission controllers recently lost communication with Ingenuity after the helicopter entered a low-power state. Now that the rotorcraft is back in contact and getting adequate energy from its solar array to charge its six lithium-ion batteries, the team is looking forward to its next flight on Mars.

Video etc at: https://mars.nasa.gov/

Lunar Libration

In lunar astronomy, libration is the wagging or wavering of the Moon perceived by Earth-bound observers and caused by changes in their perspective. It permits an observer to see slightly different hemispheres of the surface at different times. It is similar in both cause and effect to the changes in the Moon's apparent size due to changes in distance. It is caused by three mechanisms detailed below, two of which cause a relatively tiny physical libration via tidal forces exerted by the Earth. Such true librations are known as well for other moons with locked rotation.

The Moon keeps one hemisphere of itself facing the Earth, due to tidal locking. Therefore, the first view of the far side of the Moon was not possible until the Soviet probe Luna 3 reached the Moon on October 7, 1959, and further lunar exploration by the United States and the Soviet Union. This simple picture is only approximately true: over time, slightly more than half (about 59% in total) of the Moon's surface is seen from Earth due to libration.

Lunar libration arises from three changes in perspective due to: the non-circular and inclined orbit, the finite size of the Earth, and the orientation of the Moon in space. The first of these is called optical libration, the second is called parallax, and the third is physical libration. Each of these can be divided into two contributions.

The following are the four types of lunar libration:

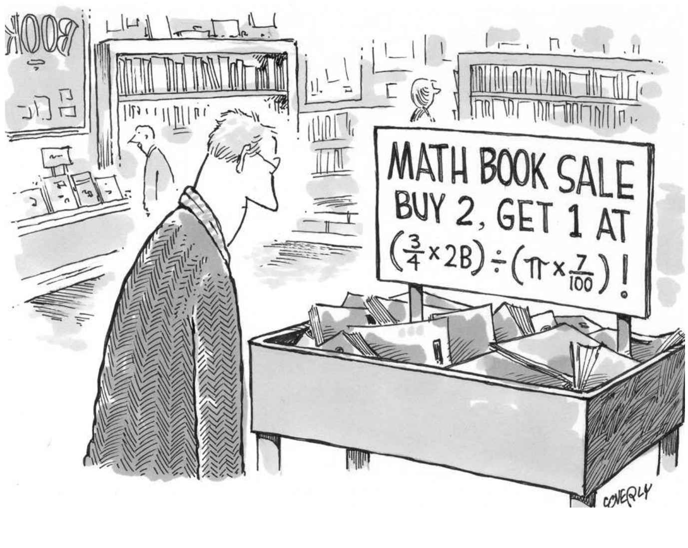
1. **Libration in longitude** results from the eccentricity of the Moon's orbit around Earth; the Moon's rotation sometimes leads and sometimes lags its orbital position. The lunar libration in longitude was discovered by Johannes Hevelius in 1648. It can reach 7°54' in amplitude.

2. **Libration in latitude** results from a slight inclination (about 6.7°) between the Moon's axis of rotation and the normal to the plane of its orbit around Earth. Its origin is analogous to how the seasons arise from Earth's revolution about the Sun. Galileo Galilei is sometimes credited with the discovery of the lunar libration in latitude in 1632, although Thomas Harriot or William Gilbert might have done so before. Note Cassini's laws. It can reach 6°50' in amplitude. The 6.7º depends on the orbit inclination of 5.15º and the negative equatorial tilt of 1.54º.

3. **Diurnal libration** is a small daily oscillation due to Earth's rotation, which carries an observer first to one side and then to the other side of the straight line joining Earth's and the Moon's centers, allowing the observer to look first around one side of the Moon and then around the other - since the observer is on Earth's surface, not at its center. It reaches less than 1° in amplitude. Diurnal libration is one effect of parallax, which depends on both the longitude and latitude of the site.

4. **Physical libration** is the oscillation of orientation in space about uniform rotation and precession. There are physical librations about all 3 axes. The sizes are roughly 100 seconds of arc. As seen from the Earth, this amounts to less than 1 second of arc. Forced physical librations can be predicted given the orbit and shape of the Moon. The periods of free physical librations can also be predicted, but their amplitudes and phases cannot be predicted.

See: https://en.wikipedia.org/wiki/Libration



Babylonian Astronomy

A Babylonian tablet recording Halley's comet in 164 BC

Babylonian astronomy was the study or recording of celestial objects during the early history of Mesopotamia.

It seemed to have focused on a select group of stars and constellations known as Ziqpu stars. These constellations may have been collected from various earlier sources. The earliest catalogue, Three Stars Each, mentions stars of the Akkadian Empire, of Amurru, of Elam and others.

A numbering system based on sixty was used, a sexagesimal system. This system simplified the calculating and recording of unusually great and small numbers. The modern practices of dividing a circle into 360 degrees, of 60 minutes each, began with the Sumerians.

During the 8th and 7th centuries BC, Babylonian astronomers developed a new empirical approach to astronomy. They began studying and recording their belief system and philosophies dealing with an ideal nature of the universe and began employing an internal logic within their predictive planetary systems. This was an important contribution to astronomy and the philosophy of science, and some modern scholars have thus referred to this novel approach as the first scientific revolution. This approach to astronomy was adopted and further developed in Greek and Hellenistic astrology. Classical Greek and Latin sources frequently use the term Chaldeans for the astronomers of Mesopotamia, who were considered as priest-scribes specializing in astrology and other forms of divination.

Only fragments of Babylonian astronomy have survived, consisting largely of contemporary clay tablets containing astronomical diaries, ephemerides and procedure texts, hence current knowledge of Babylonian planetary theory is in a fragmentary state. Nevertheless, the surviving fragments show that Babylonian astronomy was the first "successful attempt at giving a refined mathematical description of astronomical phenomena" and that "all subsequent varieties of scientific astronomy, in the Hellenistic world, in India, in Islam, and in the West … depend upon Babylonian astronomy in decisive and fundamental ways."

https://en.wikipedia.org/wiki/Babylonian_astronomy

Three decades of space telescope observations converge on a precise value for the Hubble constant

Completing a nearly 30-year marathon, NASA's Hubble Space Telescope has calibrated more than 40 "milepost markers" of space and time to help scientists precisely measure the expansion rate of the universe - a quest with a plot twist.

Pursuit of the universe's expansion rate began in the 1920s with measurements by astronomers Edwin P. Hubble and Georges Lemaître. In 1998, this led to the discovery of "dark energy," a mysterious repulsive force accelerating the universe's expansion. In recent years, thanks to data from Hubble and other telescopes, astronomers found another twist: a discrepancy between the expansion rate as measured in the local universe compared to independent observations from right after the big bang, which predict a different expansion value.

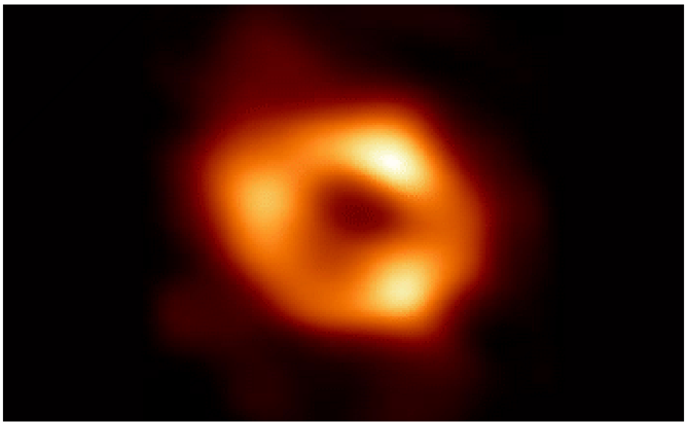
The cause of this discrepancy remains a mystery. But Hubble data, encompassing a variety of cosmic objects that serve as distance markers, support the idea that something weird is going on, possibly involving brand new physics.

"You are getting the most precise measure of the expansion rate for the universe from the gold standard of telescopes and cosmic mile markers," said Nobel Laureate Adam Riess of the Space Telescope Science Institute (STScI) and the Johns Hopkins University in Baltimore, Maryland.

NASA's new Webb Space Telescope will extend on Hubble's work by showing these cosmic milepost markers at greater distances or sharper resolution than what Hubble can see.

More at: https://phys.org/news/

We got it! Astronomers reveal first image of the black hole at the heart of our galaxy



This is the first image of Sagittarius A, or Sgr A*, the supermassive black hole at the center of our galaxy. It's the first direct visual evidence of the presence of this black hole. It was captured by the Event Horizon Telescope (EHT), an array which links together eight existing radio observatories across the planet to form a single Earth-sized virtual telescope. The telescope is named after the "event horizon", the boundary of the black hole beyond which no light can escape.*
Credit: Event Horizon Telescope collaboration

During a press conference hosted by the U.S. National Science Foundation with the Event Horizon Telescope Collaboration in Washington, D.C., astronomers unveiled the first image of the supermassive black hole at the center of our own Milky Way galaxy. This result provides overwhelming evidence that the object is indeed a black hole and yields valuable clues about the workings of such giants, which are thought to reside at the center of most galaxies. The image was produced by a global research team called the Event Horizon Telescope, or EHT, Collaboration, using observations from a worldwide network of radio telescopes.

The image is a long-anticipated look at the massive object that sits at the very center of our galaxy. Scientists had previously seen stars orbiting around something invisible, compact, and very massive at the center of the Milky Way. This strongly suggested that this object - known as Sagittarius A* (Sgr A*, pronounced "sadge-ay-star") - is a black hole, and today's image provides the first direct visual evidence of it.

Although we cannot see the black hole itself, because it is completely dark, glowing gas around it reveals a telltale signature: a dark central region (called a "shadow") surrounded by a bright ring-like structure. The new view captures light bent by the powerful gravity of the black hole, which is four million times more massive than our Sun.

"We were stunned by how well the size of the ring agreed with predictions from Einstein's Theory of General Relativity," said EHT Project Scientist Geoffrey Bower from the Institute of Astronomy and Astrophysics, Academia Sinica, Taipei. "These unprecedented observations have greatly improved our understanding of what happens at the very center of our galaxy and offer new insights on how these giant black holes interact with their surroundings."

Because the black hole is about 27,000 light-years away from Earth, it appears to us to have about the same size in the sky as a donut on the Moon. To image it, the team created the powerful EHT, which linked together eight existing radio observatories across the planet to form a single "Earth-sized" virtual telescope. The EHT observed Sgr A* on multiple nights, collecting data for many hours in a row, similar to using a long exposure time on a camera.

The breakthrough follows the EHT collaboration's 2019 release of the first image of a black hole, called M87*, at the center of the more distant Messier 87 galaxy.

The two black holes look remarkably similar, even though our galaxy's black hole is more than a thousand times smaller and less massive than M87*. "We have two completely different types of galaxies and two very different black hole masses, but close to the edge of these black holes they look amazingly similar," says Sera Markoff, Co-Chair of the EHT Science Council and a professor of theoretical astrophysics at the University of Amsterdam, the Netherlands. "This tells us that General Relativity governs these objects up close, and any differences we see further away must be due to differences in the material that surrounds the black holes."

This achievement was considerably more difficult than for M87*, even though Sgr A* is much closer to us. EHT scientist Chi-kwan ('CK') Chan, from Steward Observatory and Department of Astronomy and the Data Science Institute of the University of Arizona, U.S., explains: "The gas in the vicinity of the black holes moves at the same speed - nearly as fast as light - around both Sgr A* and M87*. But where gas takes days to weeks to orbit the larger M87*, in the much smaller Sgr A* it completes an orbit in mere minutes. This means the brightness and pattern of the gas around Sgr A* was changing rapidly as the EHT Collaboration was observing it - a bit like trying to take a clear picture of a puppy quickly chasing its tail."

More with Links: https://www.nsf.gov/

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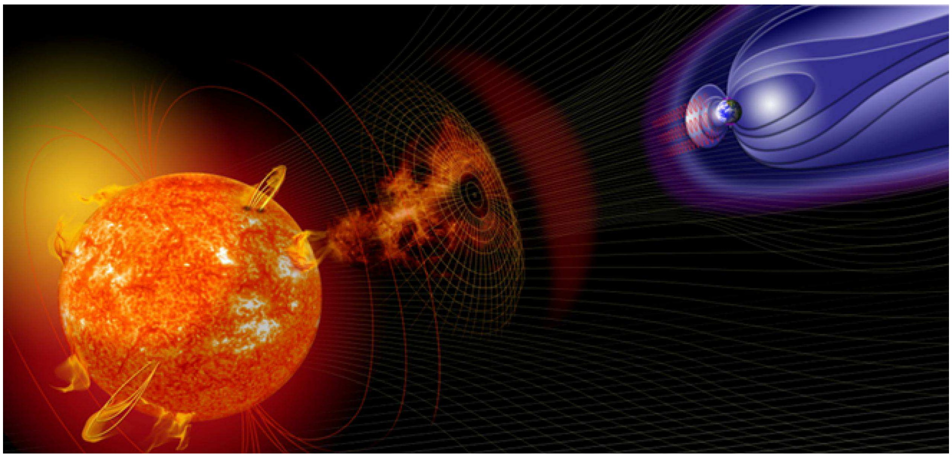
LINKS, COMMENTS AND OBSERVATIONS

Studying Space Weather



Everyone is familiar with changes in the weather on Earth. But "weather" also occurs in space. Much like terrestrial weather, space weather results from a complex system driven both by the Sun and events much closer to Earth.

Though space is about a thousand times emptier than even the best laboratory vacuums on Earth, it's not completely devoid of matter – the Sun's constant outflow of solar wind fills space with a thin and tenuous wash of particles, fields and plasma. This solar wind, along with other solar events like giant explosions called coronal mass ejections, influences the very nature of space and can interact with the magnetic systems of Earth and other worlds. Such effects also change the radiation environment through which our spacecraft – and, one day, our astronauts headed to Mars – travel. Close to Earth, such space weather can interfere with satellite electronics, communications and GPS signals, and even – when extreme – utility grids on Earth.

NOAA's Space Weather Prediction Center is the U.S. government's official source for space weather forecasts on how such events may affect Earth. NASA heliophysics works as the research arm of the nation's space weather effort, coordinating with NOAA as well as the National Science Foundation and the U.S. Geological Survey, and the U.S. Air Force Research Laboratory on the National Space Weather Action Plan.

To support space weather research, NASA observes the Sun and our space environment 24-seven with a fleet of solar observatories studying everything from the dynamics of the Sun, to the solar atmosphere, to the particles and magnetic fields in the space surrounding our home planet. Collectively, such observations help us understand the physical processes driving the space environment, which, in turn, helps to create better simulations and predictive models of this complex system – and ultimately better protect our technology and astronauts from space weather.

All of NASA's *heliophysics missions* fundamentally contribute to better understanding the physical processes driving the space environment, though the following missions are particularly focused on improving our understanding of space weather: the Advanced Composition Explorer and NOAA's Deep Space Climate Observatory, which observe space weather moving toward Earth; the Solar Dynamics Observatory, the Solar and Terrestrial Relations Observatory, the joint ESA/NASA Solar and Heliospheric Observatory, which can all observe solar eruptions on the Sun; and the Space Environment Testbeds, which tracks how space weather affects onboard electronics in space.

More information at: *https://science.nasa.gov/heliophysics/space-weather*

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

A dog has the same ecological footprint as two Toyota Landcruisers; a has cat the same environmental effect as a Volkswagen Golf; two hamsters the same as a plasma TV.

About 65 billion neutrinos will pass through your fingernail in a second.

If all the LEGO bricks ever manufactured were clipped on top of one another, they would make a tower ten times as high as the distance to the Moon.

If the Sun were the size of a beach ball then Jupiter would be the size of a golf ball and the Earth would be as small as a pea.

The average person accidentally eats 430 bugs each year of their life.

The Queen is the legal owner of one-sixth of the Earth's land surface.

If the 5 trillion spiders in Netherlands took to eating humans rather than insects, they'd consume all 16.7 million Dutch people just in three days.