New Zenith

The Monthly Newsletter of the Vectis Astronomical Society

Vol 30 Issue 9 — October 2022 *When Printed, this Newsletter costs VAS at least £1*

Society News

Late appearance of NZ again this month! Sorry to everyone but I've really only just caught up with myself this month.

Help Needed!

Please note that your Committee has two vacancies.

1. *A Secretary*
2. *A NZ Editor*

If you can help in either case please contact any of the other members listed on Page 2.

Observatory

After a recent inspection it appears we may not need to extend the observatory. That said there is quite a lot of work to get on with and as usual we will need some help.

Obviously we need to get updates and repairs done in the correct order to avoid doing the same things twice over!

Please don't be afraid to help, the work is not that onerous the thing is that "*many hands make light work*".

I'll be drawing up a work schedule in the next couple of weeks and will circulate it to all members. **If you can spare some time to help with this, it would be much appreciated.**

Observatory Visitors

Over the past few weeks we have welcomed many visitors to the observatory on Thursday evenings. Just about all of them have had clear skies for part if not all of their visits.

Old hands will know that we are approaching a pretty good time of year for observation. The combination of clear dark skies and reasonable weather gives us plenty to show visitors and at least pass on some understanding of the wonders above their heads. Thanks to all who help with these sessions.

Brian Curd

VAS Website: wightastronomy.org

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

The Editor, New Zenith
Belvedere
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

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2022 Monthly Meetings

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

Date	Subject	Speaker
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
Chairman	Bryn Davis chairman@wightastronomy.org
Secretary	**Vacant** secretary@wightastronomy.org
Treasurer	Stewart Chambers treasurer@wightastronomy.org
Observatory Director	Brian Curd director@wightastronomy.org
Programme Organiser	Simon Gardner progorg@wightastronomy.org
Astro Photography	Simon Plumley ap@wightastronomy.org
Outreach	Elaine Spear outreach@wightastronomy.org
Membership Secretary	Mark Williams members@wightastronomy.org
NZ Editor	**Help Wanted** editor@wightastronomy.org
NZ Distribution	Brian Curd distribution@wightastronomy.org
Others	Dudley Johnson

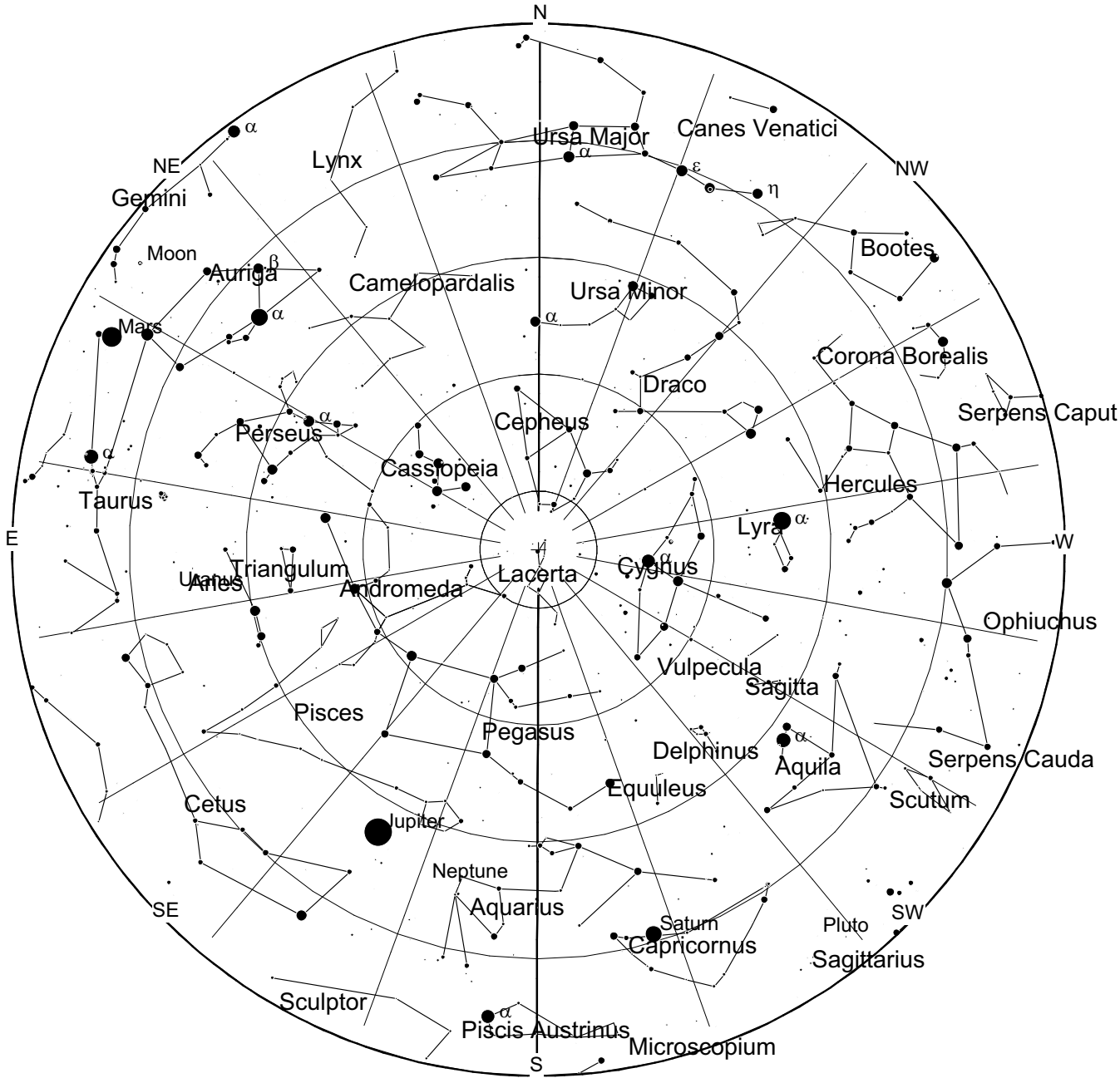
Important

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.

October 2022 - Sky Map



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

Valentina Tereshkova is an engineer, member of the Russian State Duma, and former Soviet cosmonaut. She is known for being the first and youngest woman in space, having flown a solo mission on the Vostok 6 in 1963. She orbited the Earth 48 times, spent almost three days in space, and is the only woman to have been on a solo space mission. Before selection for the Soviet space program, Tereshkova was a textile worker and an amateur skydiver. She joined the Air Force as part of the Cosmonaut Corps. After the dissolution of the first group of female cosmonauts in 1969, Tereshkova remained in the space program as a cosmonaut instructor. She later graduated and re-qualified for spaceflight but never went to space again. She retired from the Air Force in 1997 having attained the rank of major general.

October 2022 - Night Sky

Moon Phases

New	First Qtr	Full	Last Qtr
25th	3rd	10th	17th
			

Planets

Mercury

Mercury makes a good morning apparition this month, look for it low in the east before sunrise. The table shows the altitude and azimuth in degrees at 07:00.

Alt & Az For Mercury October 2022 at 07:00						
Date	**Alt**	**Az**		**Date**	**Alt**	**Az**
2nd	11	10		12th	12	103
4th	12	101		14th	11	103
6th	13	102		16th	9	103
8th	13	102		18th	7	103
10th	13	103		20th	6	103

Venus

Venus at opposition to the Sun this month and not visible.

Mars

The Earth is now closing in on Mars as it overtakes it on its orbit around the Sun and its apparent size and brightness is increasing quite rapidly. Now is the time to start observing the Red Planet as we make a close approach over the next few months. Although Mars rises at about 21:00 it is best observed at after midnight and during the early morning hours when it is well clear of the horizon. It can be found in the constellation of Taurus above the head of Orion. It is now quite bright and easily identified making a distinct triangle with the red stars Betelgeuse and Aldabaran. A telescope will show surface markings, and there are only a short time every two years to observe them so make the most of the next few months.

Jupiter

Jupiter is very conspicuous in the east as the sky darkens. It is much brighter than any other star like object in the sky at this time. It has just passed opposition and is very well placed for observation all night.

Saturn

Although rather low in the southern sky in the constellation of Capricornus, Saturn is well quite placed for observation from the onset of darkness until it drops into he haze near the horizon. Look to the south about an outstretched hand's width above the horizon at about 21:00, Saturn is the brightest object to be found in that part of the sky It is noticeably yellow compared to he much brighter Jupiter further to the east.

Uranus

Uranus is in the Constellation of Ares, but is not located close to any easily located guide stars making it difficult to locate without a star chart. Use the finder chart in September New Zenith or a planetarium program to locate it on the night of observation. It is an easy binocular object once you know where to look.

Neptune

Neptune is in the constellation of Aquarius close to the border of Pisces and like Uranus is not near any easy guide stars. It is quite faint, but still not a difficult binocular object. It can be found about half way between Jupiter and the fourth magnitude start Phi Aquarii, As with Uranus a planetarium program will assist in finding this outer planet

Deep Sky

NGC7000 North America Nebula RA 20h 59m Dec 44° 28' mag 4.0

Located 3 degrees to the east of Deneb in Cygnus is this large misty patch in the Milky Way that can be seen with the naked eye. Unless the sky is very dark this nebulosity is the light from the myriad of background stars, if conditions are suitable the darker rift of the 'Gulf of Mexico' can be visualised. Large aperture binoculars or a rich field telescope will help reveal the nebulosity. Most of the light emitted is the deep red of hydrogen alpha, to which our eyes lack sensitivity. A nebula filter can help to increase the contrast with the background sky glow. This is a rewarding area for long exposure photography.

M39 Open Cluster RA 21h 32m Dec 48° 26' mag 4.6

An open cluster with an apparent diameter equal to that of the full moon, it is rather sparsely populated triangular shaped grouping with around 30 magnitude 7 to 9 stars. This like many galactic clusters is an object best enjoyed through binoculars or a low powered telescope.

Melotte 20 Open Cluster RA 3h 20m Dec 49° 2' mag 1.2

Centred on Mirfack, Alpha Persei and easily visible to the naked eye this magnificent cluster is best observed using binoculars. The view is that of a multitude of dazzlingly bright blue stars centred on the bright Mirfack. This cluster is rather too large for a telescope but ideal for binoculars.

Peter Burgess

Small craters add up to wandering poles on moon, NASA study finds

The moon's craters preserve billions of years of history. Scientists have learned about the conditions of our early solar system by studying the composition, size, and distribution of these holes in the moon's surface, created long ago by collisions with asteroids.

But instead of directly studying the characteristics of these holes, a team based at NASA's Goddard Space Flight Center in Greenbelt, Maryland, decided to try something different. Using computer simulations, they "erased" thousands of craters from the moon's surface, as if turning back the clock 4.25 billion years to a time before the craters formed. They found that the locations of the moon's north and south poles moved slightly over this time period.

As the moon shifted this way and that from the effects of asteroid impacts, the location of the poles "wandered" 10 degrees in latitude (or 186 miles / 300 kilometers), scientists reported on Sept. 19 in The Planetary Science Journal. Geographic north and south poles lie where a celestial body's rotational axis intersects with its surface. In this case, the moon's rotational axis, the imaginary line that passes through its center and around which it rotates, stayed the same as the body of the moon shifted.

Information about wandering poles can be useful for understanding the evolution of the moon; specifically, the condition of resources, such as water, on its surface. Scientists have found frozen water in shadowed regions near the moon's poles, but they don't yet know how much is there. If the moon had drastically shifted the locations of its poles toward a warmer, less shadowed region, such as the equator, some frozen water could have sublimated (changed from a solid state to a gaseous state) off the surface, with new water having had less time to accumulate at the new poles.

But, says Vishnu Viswanathan, a NASA Goddard scientist who led the study, "Based on the moon's cratering history, polar wander appears to have been moderate enough for water near the poles to have remained in the shadows and enjoyed stable conditions over billions of years."

The phenomenon behind the shifting poles is known as True Polar Wander, and it's what happens under the laws of physics to an object, in this case the moon, that's trying to keep itself spinning when faced with obstacles, such as changes to the way its mass is distributed.

As asteroid impacts excavated mass, leaving depressions in the surface - or pockets of lower mass - the moon reoriented itself to bring those pockets toward the poles, while bringing areas of higher mass out toward the equator via centrifugal force. It's the same force that acts on dough when a pizza maker tosses and spins it in the air to stretch it out.

To determine the degree of the moon's polar wander, Viswanathan partnered with several scientists, including David E. Smith, principal investigator for the Lunar Orbiter Laser Altimeter (LOLA), aboard NASA's Lunar Reconnaissance Orbiter (LRO) spacecraft. Smith became interested in using gravity data to figure out how far the moon's poles have wandered after serving as deputy principal investigator of NASA's Gravity Recovery and Interior Laboratory (GRAIL) mission. GRAIL mapped the moon's gravity field in great detail before the mission ended in 2012.

"If you look at the moon with all these craters on it, you can see those in the gravity field data," said Smith, of the Massachusetts Institute of Technology in Cambridge. "I thought, 'Why can't I just take one of those craters and suck it out, remove the signature completely?'"

Smith, Viswanathan, and their team worked with about 5,200 craters - ranging in size from 12 miles (20 kilometers) to 746 miles (1,200 kilometers) wide. They designed computer models that took the coordinates and widths of all these craters from topographical maps of the moon made with LOLA data and then found their corresponding gravitational signatures - or pockets of higher or lower gravity - on a gravity map from GRAIL. The scientists then ran simulations that removed the gravitational signatures of each crater sequentially by age, essentially rewinding the evolution of the moon and inching the poles back towards their ancient locations with each impact eliminated.

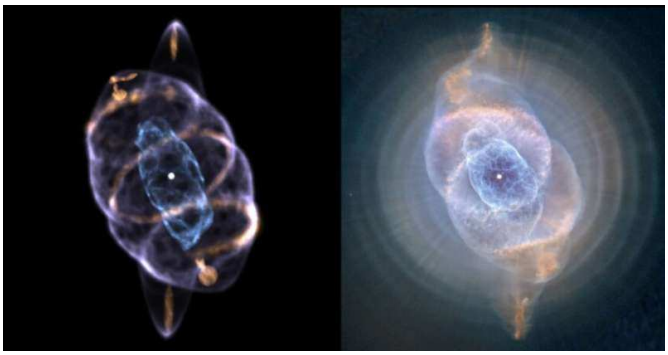
While other researchers studying polar wander have removed craters from the record, they've removed only a couple dozen of the largest ones. "People assumed that small craters are negligible," said Viswanathan. "They're negligible individually, but collectively they have a large effect."

Viswanathan said his team is getting closer to figuring out the true degree of polar wander on the moon, but the scientists still need to refine their estimate. They plan to erase more small craters from the moon and to remove other features, such as volcanic eruptions, that could have contributed to shifting the poles.

"There are a few things that we haven't taken into account yet, but one thing we wanted to point out is those small craters that people have been neglecting, they actually do matter, so that is the main point here," said Sander Goossens, a Goddard planetary scientist who participated in the study.

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

Cat's Eye Nebula seen in 3D



Side-by-side comparison of the three-dimensional model of the Cat's Eye Nebula created by Clairmont and the Cat's Eye Nebula from the Hubble Space Telescope. Credit: Ryan Clairmont (left), NASA, ESA, HEIC, and The Hubble Heritage Team (STScI/AURA) (right)

Researchers have created the first computer-generated three-dimensional model of the Cat's Eye Nebula, revealing a pair of symmetric rings encircling the nebula's outer shell. The rings' symmetry suggests they were formed by a precessing jet, providing strong evidence for a binary star at the center of the nebula. The study was led by Ryan Clairmont, who recently completed secondary school in the United States, and is published in Monthly Notices of the Royal Astronomical Society.

A planetary nebula forms when a dying solar-mass star ejects its outer layer of gas, creating a colourful, shell-like structure distinctive to these objects. The Cat's Eye Nebula, also known as NGC 6543, is one of the most complex planetary nebulae known. It is just over 3,000 light-years away from Earth, and can be seen in the constellation Draco. The Cat's Eye Nebula has also been imaged by the Hubble Space Telescope in high resolution, revealing an intricate structure of knots, spherical shells, and arc-like filaments.

The nebula's mysterious structure confounded astrophysicists because it could not be explained by previously accepted theories for planetary nebula formation. More recent research showed that precessing jets were potential shaping mechanisms in complex planetary nebulae such as NGC 6543, but lacked a detailed model.

Ryan Clairmont, an astronomy enthusiast, decided to try to establish the detailed 3D structure of the Cat's Eye to find out more about the potential mechanism that gave it its intricate shape. To do this, he sought out the help of Dr. Wolfgang Steffen of The National Autonomous University of Mexico and Nico Koning from the University of Calgary, who developed SHAPE, 3D astrophysical modeling software particularly suitable for planetary nebulae.

To reconstruct the nebula's three-dimensional structure, the researchers used spectral data from the San Pedro Martir National Observatory in Mexico. These provide detailed information on the internal motion of material in the nebula. Together with these data and images from the Hubble Space Telescope, Clairmont constructed a novel 3D model, establishing that rings of high-density gas were wrapped around the outer shell of the Cat's Eye. Surprisingly, the rings are almost perfectly symmetric to each other, suggesting they were formed by a jet - a stream of high-density gas ejected in opposite directions from the nebula's central star.

The jet exhibited precession, similar to the wobbling motion of a spinning top. As the jet wobbled, or precessed, it outlined a circle, creating the rings around the Cat's Eye. However, the data indicates the rings are only partial, meaning the precessing jet never completed a full 360-degree rotation, and that the emergence of the jets was only a short-lived phenomenon. The duration of outflows is an important piece of information for the theory of planetary nebulae. Since only binary stars can power a precessing jet in a planetary nebula, the team's findings are strong evidence that a system of this type exists at the center of the Cat's Eye.

As the angle and direction of the jet changed over time, it likely formed all of the features seen in the Cat's Eye, including the jets and knots. Using the three-dimensional model, the researchers were able to calculate the tilt and opening angle of the precessing jet based on the orientation of the rings.

Ryan Clairmont, the lead author of the paper and now a prospective undergraduate at Stanford University, says "When I first saw the Cat's Eye Nebula, I was astounded by its beautiful, perfectly symmetric structure. I was even more surprised that its 3D structure was not fully understood."

He adds, "It was very rewarding to be able to do astrophysical research of my own that actually has an impact in the field. Precessing jets in planetary nebulae are relatively rare, so it's important to understand how they contribute to the shaping of more complex systems like the Cat's Eye. Ultimately, understanding how they form provides insight into the eventual fate of our Sun, which will itself one day become a planetary nebula."

From: https://phys.org/news/

A Protogalaxy in the Milky Way may be our Galaxy's Original Nucleus

A population of millions of stars near the center of the Milky Way (shown) is the original seed from which the galaxy grew, researchers say. The eight-star "teapot" in the constellation Sagittarius can be seen on the left. Credit: TERENCE DICKINSON/ESA

The Milky Way left its "poor old heart" in and around the constellation Sagittarius, astronomers report. New data from the Gaia spacecraft reveal the extent of what seems to be the galaxy's original nucleus - the ancient stellar population that the rest of the Milky Way grew around - which came together more than 12.5 billion years ago.

"People have long speculated that such a vast population [of old stars] should exist in the center of our Milky Way, and Gaia now shows that there they are," says astronomer Hans-Walter Rix of the Max Planck Institute for Astronomy in Heidelberg, Germany.

The Milky Way's ancient heart is a round protogalaxy that spans nearly 18,000 light-years and possesses roughly 100 million times the mass of the sun in stars, or about 0.2 percent of the Milky Way's current stellar mass, Rix and colleagues report in a study posted September 7 at arXiv.org.

"This study really helps to firm up our understanding of this very, very, very young stage in the Milky Way's life," says Vasily Belokurov, an astronomer at the University of Cambridge who was not involved in the work. "Not much is really known about this period of the Milky Way's life," he says. "We've seen glimpses of this population before," but the new study gives "a bird's-eye view of the whole structure."

Most stars in the Milky Way's central region abound with metals, because the stars originated in a crowded metropolis that earlier stellar generations had enriched with those metals through supernova explosions. But Rix and his colleagues wanted to find the exceptions to the rule, stars so metal-poor they must have been born well before the rest of the galaxy's stellar denizens came along - what Rix calls "a needle-in-a-haystack exercise."

His team turned to data from the Gaia spacecraft, which launched in 2013 on a mission to chart the Milky Way. The astronomers searched about 2 million stars within a broad region around the galaxy's center, which lies in the constellation Sagittarius, looking for stars with metal-to-hydrogen ratios no more than 3 percent of the sun's.

The astronomers then examined how those stars move through space, retaining only the ones that don't dart off into the vast halo of metal-poor stars engulfing the Milky Way's disk. The end result: a sample of 18,000 ancient stars that represents the kernel around which the entire galaxy blossomed, the researchers say. By accounting for stars obscured by dust, Rix estimates that the protogalaxy is between 50 million and 200 million times as massive as the sun.

"That's the original core," Rix says, and it harbors the Milky Way's oldest stars, which he says probably have ages exceeding 12.5 billion years. The protogalaxy formed when several large clumps of stars and gas conglomerated long ago, before the Milky Way's first disk - the so-called thick disk - arose.

The protogalaxy is compact, which means little has disturbed it since its formation. Smaller galaxies have crashed into the Milky Way, augmenting its mass, but "we didn't have any later mergers that deeply penetrated into the core and shook it up, because then the core would be larger now," Rix says.

The new data on the protogalaxy even capture the Milky Way's initial spin-up - its transition from an object that didn't rotate into one that now does. The oldest stars in the proto–Milky Way barely revolve around the galaxy's center but dive in and out of it instead, whereas slightly younger stars show more and more movement around the galactic center. "This is the Milky Way trying to become a disk galaxy," says Belokurov, who saw the same spin-up in research that he and a colleague reported in July.

Today, the Milky Way is a giant galaxy that spins rapidly - each hour our solar system speeds through 900,000 kilometers of space as we race around the galaxy's center. But the new study shows that the Milky Way got its start as a modest protogalaxy whose stars still shine today, stars that astronomers can now scrutinize for further clues to the galaxy's birth and early evolution.

From: https://www.sciencenews.org/

New Webb Telescope Image of Neptune Captures Ring Details

Webb's Near-Infrared Camera (NIRCam) image of Neptune, taken on July 12, 2022, brings the planet's rings into full focus for the first time in more than three decades. Credit: Image: NASA, ESA, CSA, STScI, Image Processing: Joseph DePasquale (STScI)

At an average distance of 2.8 billion miles from the Sun, Neptune lurks in one of the dimmest parts of our solar system. Neptune has long perplexed astronomers, with its bizarre moon, Triton, complex rings, and roaring winds that blow faster than the speed of sound here on Earth. Just one spacecraft, Voyager 2, has ever visited this far-flung planet, and observations from both space and ground-based telescopes over the years have tracked the many turbulent storms.

With its first image of Neptune, NASA's James Webb Space Telescope is showcasing its impressive capabilities closer to home. Not only has Webb captured the clearest view of this distant planet's rings in more than 30 years, but its cameras also reveal details of the ice giant in a whole new light.

Most striking in Webb's new image is the sharp, crisp view of the planet's rings. In fact, some of these rings have not been detected since NASA's Voyager 2 became the first spacecraft to observe Neptune during its flyby in 1989. In addition to several bright, narrow rings, the Webb image precisely reveals Neptune's fainter dust bands.

Ever since its discovery in 1846, Neptune has fascinated researchers. Located about 30 times farther from the Sun than Earth, Neptune orbits in the remote, dark region of the outer solar system. At that extreme distance, the Sun is so faint and tiny that high noon on Neptune is similar to a dim twilight on Earth.

Due to the chemical make-up of its interior, Neptune is characterized as an ice giant. The planet is much richer in elements heavier than hydrogen and helium compared to the gas giants, Jupiter and Saturn. This is readily apparent in Neptune's signature blue appearance in Hubble Space Telescope images at visible wavelengths, which is caused by small amounts of gaseous methane.

Neptune does not appear blue to Webb, because the observatory's Near-Infrared Camera (NIRCam) images objects in the near-infrared range from 0.6 to 5 microns. In fact, the methane gas so strongly absorbs red and infrared light that the planet is quite dark at these near-infrared wavelengths, except where high-altitude clouds are present. Such methane-ice clouds are prominent as bright streaks and spots, which reflect sunlight before it is absorbed by methane gas. These rapidly evolving cloud features have been recorded over the years in images from other observatories, including the Hubble Space Telescope and the W.M. Keck Observatory.

More subtly, a thin line of brightness circling the planet's equator could be a visual signature of global atmospheric circulation that powers Neptune's winds and storms. The atmosphere descends and warms at the equator, and thus glows at infrared wavelengths more than the surrounding, cooler gases.

Neptune's 164-year orbit means its northern pole, at the top of this image, is just out of view for astronomers. However, the Webb images hint at an intriguing brightness in that area. A previously-known vortex at the southern pole is evident in Webb's view, but for the first time, Webb has revealed a continuous band of high-latitude clouds surrounding it.

Webb also captured seven of Neptune's 14 known moons. Dominating this Webb portrait of Neptune is a very bright point of light sporting the signature diffraction spikes seen in many of Webb's images, but this is not a star. Rather, this is Neptune's large and unusual moon, Triton.

Covered in a frozen sheen of condensed nitrogen, Triton reflects an average of 70 percent of the sunlight that hits it. It far outshines Neptune in this image because the planet's atmosphere is darkened by methane absorption at these near-infrared wavelengths. Triton orbits Neptune in an unusual backward (retrograde) orbit, leading astronomers to speculate that this moon was originally a Kuiper belt object that was gravitationally captured by Neptune. Additional Webb studies of both Triton and Neptune are planned in the coming year.

From: https://scitechdaily.com/

How Global Warming Affects Astronomical Observations

The quality of ground-based astronomical observations delicately depends on the clarity of the atmosphere above the location from which they are made. Sites for telescopes are therefore very carefully selected. They are often high above sea level, so that less atmosphere stands between them and their targets. Many telescopes are also built in deserts, as clouds and even water vapor hinder a clear view of the night sky.

A team of researchers led by the University of Bern and the National Centre of Competence in Research (NCCR) PlanetS shows in a study, published in the journal Astronomy & Astrophysics and presented at the Europlanet Science Congress 2022 in Granada, how one of the major challenges of our time - anthropogenic climate change - now even affects our view of the cosmos.

A blind spot in the selection process

"Even though telescopes usually have a lifetime of several decades, site selection processes only consider the atmospheric conditions over a short timeframe. Usually over the past five years - too short to capture long-term trends, let alone future changes caused by global warming," Caroline Haslebacher, lead author of the study and researcher at the NCCR PlanetS at the University of Bern, points out.

The team of researchers from the University of Bern and the NCCR PlanetS, ETH Zurich, the European Southern Observatory (ESO) as well as the University of Reading in the UK therefore took it upon themselves to show the long-term perspective.

Worsening conditions around the globe

Their analysis of future climate trends, based on high resolution global climate models, shows that major astronomical observatories from Hawaii to the Canary Islands, Chile, Mexico, South Africa and Australia will likely experience an increase in temperature and atmospheric water content by 2050. This, in turn, could mean a loss in observing time as well as a loss of quality in the observations.

"Nowadays, astronomical observatories are designed to work under the current site conditions and only have a few possibilities for adaptation. Potential consequences of the climatic conditions for telescopes therefore include a higher risk of condensation due to an increased dew point or malfunctioning cooling systems, which can lead to more air turbulence in the telescope dome," Haslebacher says.

The fact that the effects of climate change on observatories had not been taken into account before was not an oversight, as study co-author Marie-Estelle Demory says, but more due to modeling limitations. "This is the first time that such a study has been possible. Thanks to the higher resolution of the global climate models developed through the Horizon 2020 PRIMAVERA project, we were able to examine the conditions at various locations of the globe with great fidelity - something that we were unable to do with conventional models. These models are valuable tools for the work we do at the Wyss Academy," says the senior scientist at the University of Bern and member of the Wyss Academy for Nature.

"This now allows us to say with certainty that anthropogenic climate change must be taken into account in the site selection for next-generation telescopes, and in the construction and maintenance of astronomical facilities," says Haslebacher.

More at: https://phys.org/

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

Monthly Talk – September 2022: Jonathan Clough on "Kristian Birkeland"

We were delighted to welcome **Jonathan Clough** as our guest at the Newchurch Pavilion. He is an experienced and engaging speaker who is very active in the Cambridge Astronomical Association. He teaches introductory astronomy at the University, broadcasts on community radio and runs Young Astronomers sessions. I would like to acknowledge his generosity in giving me access to his presentation and some related documents. (We are also grateful to Dudley Johnson who recommended Jonathan, after hearing him lecture on a Northern Lights cruise.)

A Famous Norwegian

Figure 1 - portrait of Kristian Birkeland and the aurora borealis over Longyearbyen, Svalbard (credits: Hanne Utigard / Ludvig Forbech / Yngve Vogt

His talk introduced us to Kristian Birkeland (1867-1917), now acknowledged as "The Father of Northern Lights understanding", but whose brilliant scientific work was overlooked long after his death. Outside of Norway, where he appeared on their banknotes and Norwegian Airlines tailfin art(!), he is still little known. We struggled to name many famous Norwegians, and I had temporarily forgotten the current World Chess Champion Magnus Carlsen – How many can you come up with?

Jonathan took us on a tour through Birkeland's extraordinary life, from sickly youth to troubled and eccentric scientist. His health was dogged by mental illness and dependence on whisky and sleeping potions, yet he was a hugely inventive and determined scientist. His life appears to have been beset by financial and personal troubles, and punctuated by regular explosions! He developed a high-voltage switch for power plants, which caused a catastrophic fire; this inspired him to invent an electric "cannon" which provided funds for later activities, but which exploded spectacularly in a large-scale public demonstration, but he had accidentally invented a way of producing artificial lightning, which he then harnessed in a machine to capture nitrogen for a very lucrative fertiliser factory. Far from being deterred by setbacks, each one seemed to "spark" more ideas to investigate, and more inventions to be patented.

Theories, Expeditions and Experiments

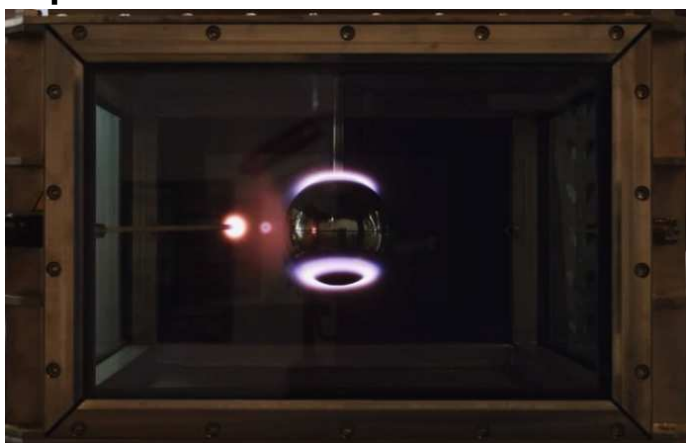

Figure 2 - Birkeland's "Terella": from a video re-creating his experiment to demonstrate how the aurorae are formed. A magnetized sphere representing the Earth is placed in the path of accelerated electrons coming from the cathode on the left.

In the 1890s he may well have discovered X-ray before Röntgen in Germany and was experimenting with Cathode Rays (accelerated electrons) around the same time that JJ Thomson was "discovering" the electron in England. Birkeland had studied under Heinrich Hertz, another of Europe's greatest physicists and was determined to put his theories of electromagnetism to use in understanding the Aurora Borealis. There were competing hypotheses about how the Northern Lights were produced, such as Halley's leakage of the Earth's "magnetic fluid", or von Triewald's sunlight striking vapours in the atmosphere, and other conjectures linking the aurora to weather forecasts. Birkeland, however, had an early obsession with the Northern Lights and proposed that they were caused by electrons streaming from the sun and interacting with the Earth's magnetic field. He later successfully demonstrated the effect with his "Terella" (see Figure 2).

Birkeland led a series of expeditions to observe and measure the phenomenon. The first involved a team over-wintering at two mountain-top locations in order to determine the height of aurorae by triangulation. This was of limited success because the baseline between stations

was not enough because aurorae are typically above 100 km above sea level, and ended tragically when two people died in an avalanche when coming down the mountain.

A later expedition was more ambitious with widely-separated observing stations in Norway, Iceland, Svalbard and the Russian island of Novaja Semlja. The results were more reliable and proved the altitude at which the Northern Lights occur. His publication *The Norwegian Aurora Polaris Expedition 1902-03* was his masterwork, appearing in two sections, the first in 1908 and the second in 1913, a total of 991 pages. Enlightening, but not light reading.

The Fez

Figure 3 - The be-fezzed Kristian Birkeland at work in his lab with vacuum tubes

Something of the Norwegian's eccentricity was evoked by Jonathan delivering the end of his lecture in a fez, just as Egypt-obsessed Birkeland wore in his lab (see Figure 3). The man's life was so full of remarkable things, that nothing could have surprised us by the end. Of course he had been treated for rabies in Moscow after being bitten by a dog on the second expedition; of course he had to hurry from giving a lecture because he'd forgotten he was getting married that afternoon; of course he had a menagerie in Egypt and was on a committee to debunk spirit mediums while his wife amused herself with seances at home. What next?! Patents for rocket propulsion ion drive? And a radio-active shirt to treat cancer? Well, yes & yes actually! Birkeland bristled with ideas, but suffered from some bad business partnerships and was terrible at the work-life balance. His death aged only 49 in a Tokyo hotel was rather sad, by his own hand, evidently.

A Legacy

Birkeland's explanation of the Northern Lights had been publicly dismissed in his lifetime by the influential physicists Sydney Chapman and Lord Kelvin, on the grounds that "currents could not cross the vacuum of space". It took until 1962, when the Mariner II spacecraft confirmed the existence of the solar wind and for Birkeland to be exonerated: space was indeed full of particles streaming from the Sun. Later in the 1960s satellite measurements of magnetic disturbances near the Earth's poles further confirmed his work and resurrected his reputation. There is still much to learn about the Northern Lights, but Kristian Birkeland – seven times nominated but never awarded a Nobel Prize – laid the foundations for what we know now.

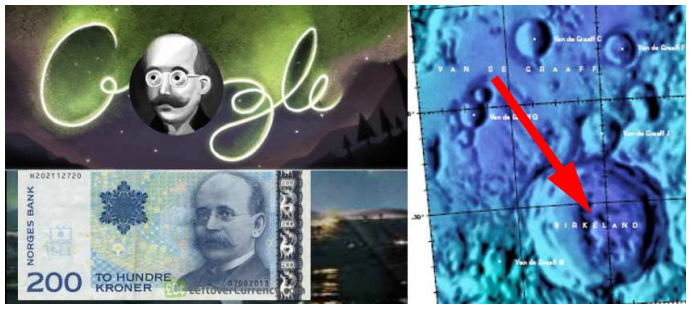

Figure 4 - Kristian Birkeland remembered in a Google Doodle, the 200 Kroner banknote and a crater on the Moon.

Suggested Links

General information.

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

Kristian Birkeland's report from his 3rd Expedition.

https://cds.cern.ch/record/1395529/files/norwegianaurorap01chririch.pdf

A good starting point for understanding the current theories of how the Northern (and Southern) Lights happens, but it begins "A full understanding of the physical processes which lead to different types of auroras is still incomplete".

https://en.wikipedia.org/wiki/Aurora#Causes

The NASA page showing the beautiful images of aurorae on Jupiter, taken by the James Webb Space Telescope.

https://blogs.nasa.gov/webb/2022/08/22/webbs-jupiter-images-showcase-auroras-hazes/

Reported by: Simon Gardner

THE BACK PAGE

LINKS, COMMENTS AND OBSERVATIONS

Learn About the True Speed of Light

Light moves through the universe at the fastest speed astronomers can measure. In fact, the speed of light is a cosmic speed limit, and nothing is known to move faster. How fast does light move? This limit can be measured and it also helps define our understanding of the universe's size and age.

What Is Light: Wave or Particle?

Light travels fast, at a velocity of 299,792,458 meters per second. How can it do this? To understand that, it's helpful to know what light actually is and that's largely a 20th-century discovery.

The nature of light was a great mystery for centuries. Scientists had trouble grasping the concept of its wave and particle nature. If it was a wave what did it propagate through? Why did it appear to travel at the same speed in all directions? And, what can the speed of light tell us about the cosmos? It wasn't until Albert Einstein described this theory of special relativity in 1905 it all came into focus. Einstein argued that space and time were relative and that the speed of light was the constant that connected the two.

What Is the Speed of Light?

The value of 299,792,458 meters per second is the speed of light in a vacuum. However, light actually slows down as it passes through different media. Even in air, which is nearly a vacuum, light slows down slightly. As it moves through space, it encounters clouds of gas and dust, as well as gravitational fields, and those can change the speed a tiny bit.

This phenomenon has to do with the nature of light, which is an electromagnetic wave. As it propagates through a material its electric and magnetic fields "disturb" the charged particles that it comes in contact with. These disturbances then cause the particles to radiate light at the same frequency, but with a phase shift. The sum of all these waves produced by the "disturbances" will lead to an electromagnetic wave with the same frequency as the original light, but with a shorter wavelength and, hence a slower speed.

Interesting, as fast as light moves, its path can be bent as it passes by regions in space with intense gravitational fields.

Travel Times for Light

One of the questions that astronomers get from members of the public is: "how long would it take light to go from object X to Object Y?" Light gives a very accurate way to measure the size of the universe by defining distances. Here are a few of the common distance measurements:

The Earth to the Moon: *1.255 seconds*

The Sun to Earth: *8.3 minutes*

Our Sun to the next closest star: *4.24 years*

Across our Milky Way galaxy: *100,000 years*

To the closest spiral galaxy (Andromeda): *2.5 million years*

Limit of the observable universe to Earth: *13.8 billion years*

More info at: https://www.thoughtco.com/speed-of-light-3072257

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

Your eyes take about an hour to adjust to darkness. *After that they become 100,000 times more sensitive to light.*

Venus is the only planet to spin clockwise. *Our Solar System started off as a swirling cloud of dust and gas which eventually collapsed into a spinning disc with the Sun at its centre. Because of this common origin, all the planets move around the Sun in the same direction and on roughly the same plane. They also all spin in the same direction (counterclockwise, observed from 'above') – except Uranus and Venus. Uranus spins on its side, while Venus spins in the complete opposite direction. The most likely cause of these planetary oddballs are gigantic asteroids which knocked them off course in the distant past.*

About 96% of the universe is made up of dark matter and dark energy, which are undetectable to humans. It's believed this is because the particles that make up these substances don't interact with regular matter or light.