New Zenith

The Monthly Newsletter of the Vectis Astronomical Society

Vol 31 Issue 5 — June 2023

When Printed, this Newsletter costs VAS at least £1

Society News

Observatory Repairs

The observatory dome is currently under repair and refurbishment and cannot be used until further notice.

The work will take some time to complete but will result in

- Additional & improved weatherproofing
- Simplified wiring
- Modernised remote telescope control
- Improved camera facilities
- Automatic dome positioning

If you can help with the work, please contact any Committee Member for details.

Events

As usual VAS will be attending the Garlic Festival and Wolverton Manor again this year.

The **Garlic Festival** is a major fund raising event for us as we are paid for providing site marshals over the weekend. This years dates are Saturday & Sunday 19th - 20th August.

The **Wolverton Manor Garden Fair** takes place on Saturday & Sunday 2nd - 3rd September 2023. VAS will have a stall alongside the AONB.

If you can help with either event, please contact Richard Flux

August AGM

It's only a couple of months until AGM time again!

At the moment two committee vacancies are available

1. Committee Secretary
2. New Zenith Editor

An application form will be attached to the next New Zenith.

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

Contents this Month

2023 Monthly Meetings

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

Date	Subject	Speaker
23 Jun	**ZOOM only** Stellar Evolution - the life cycle of a star and its implications for life in our Solar System	Dr Elizabeth Cunningham
28 Jul	Variable Stars	Bryn Davis
25 Aug	AGM	**Meeting in the Observatory**
22 Sep	**ZOOM Only** Celestial Hide and Seek Eclipses, Transits and Occultations	Martin Lunn
27 Oct	**ZOOM Only** The Great Debate (The Shapley-Curtiss Debate of 1920)	Nick Hewitt
24 Nov	EM-bridge technology and applications	Alan Thomson
2024 Monthly Meetings		
2024 26 Jan	GW Astronomy - Updates from the LIGO/Virgo/ KAGRA 4th Observing Run	Dr Laura Nuttall

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.

GDPR rules mean we must maintain accurate membership records, please tell us if your contact details changes

VAS Contacts 2023

President	Barry Bates president@wightastronomy.org
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NZ Distribution	Brian Curd distribution@wightastronomy.org
Others	Dudley Johnson

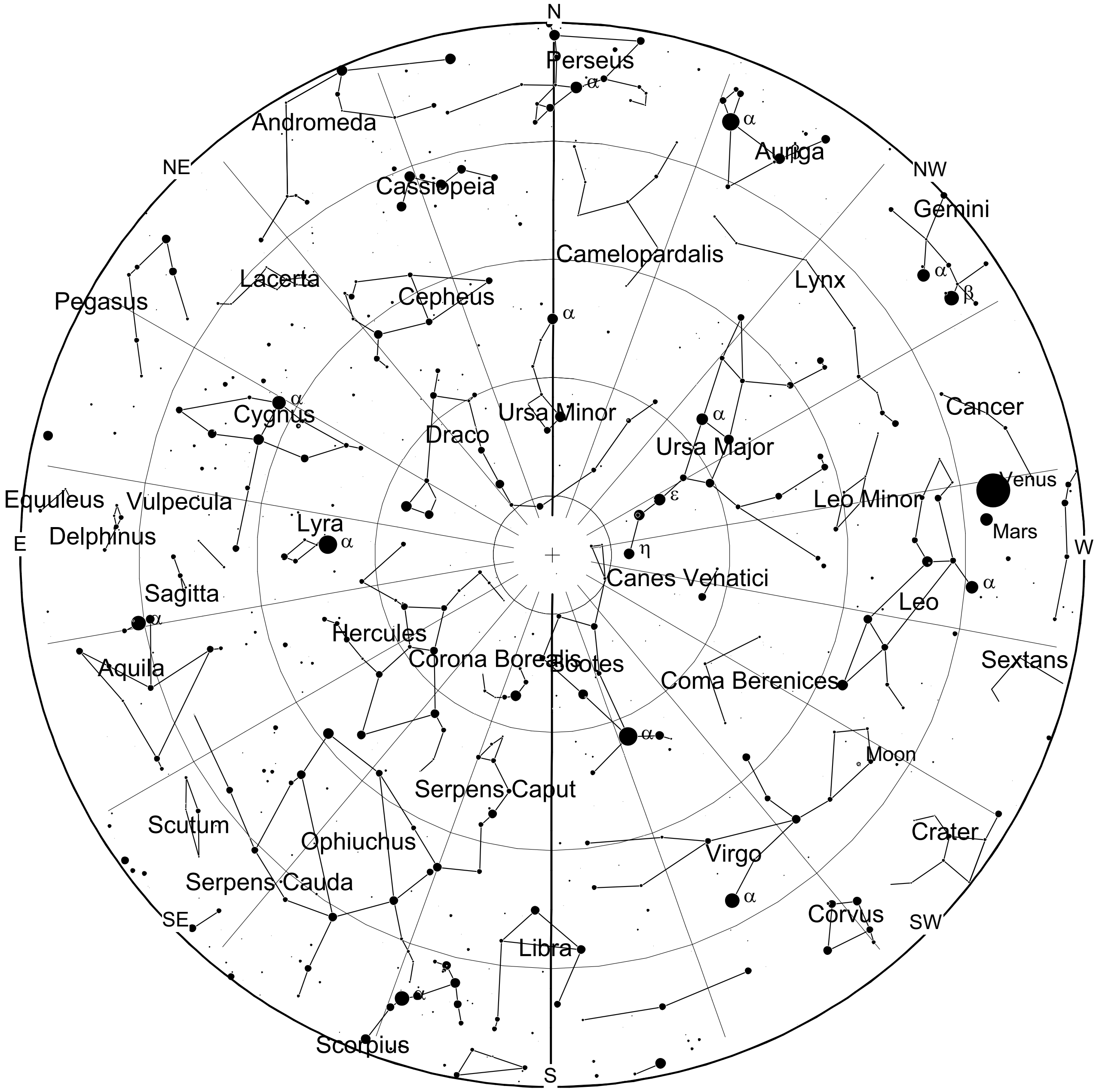
Important

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.

June 2023 - Sky Map



View from Newchurch Isle of Wight UK - 2200hrs - 20 June 2023

Messier 4 or M4 is a globular cluster in the constellation of Scorpius. It was discovered by Philippe Loys de Chéseaux in 1745 and catalogued by Charles Messier in 1764. It was the first globular cluster in which individual stars were resolved.

M4 is conspicuous in even the smallest of telescopes as a fuzzy ball of light. It appears about the same size as the Moon in the sky. It is one of the easiest globular clusters to find, being located only 1.3 degrees west of the bright star Antares, with both objects being visible in a wide-field telescope. Modestly sized telescopes will begin to resolve individual stars, of which the brightest in M4 are of apparent magnitude 10.8.

June 2023 - 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	4th	21st

Planets

Mercury

Towards the end of the month 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 hour before the Sun. At this time it is not very bright, about magnitude 0.6 about the same as the brighter stars, it will be quite difficult to see against the pre-dawn sky. It gets as the apparition ends, but also in the brighter sky closer to the Sun. 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 3 degrees 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**	**Alt**	**Az**
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 2 degrees 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 The Cat's Eye, 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

Astronomers figured out clever tricks to reduce the impact of satellite trails

A long-exposure image of the Orion Nebula with a total exposure time of 208 minutes showing satellite trails in mid-December 2019. Credit: A. H. Abolfath

A clear sky is a prerequisite for most astronomers imaging the cosmos. However, with the proliferation of satellite trails, astronomers see a lot more streaks in their images. That's particularly true for people using professional ground-based and orbiting telescopes. When Hubble Space Telescope opened its eye on the sky, there were less than 500 satellites orbiting our planet. Now, there are nearly 8,000 of them, leaving their mark across the sky.

The pencil-thin streaks in HST images have the potential to “eclipse” a crucial target. Or, they might ruin an entire observing run. The telescope is not cheap to run, so a photobombed observation costs the taxpayers plenty of money. So, what do HST astronomers do if a satellite streak appears?

It turns out satellite trails are not as much of an issue for that telescope as they are for others. That's because there's a trick available for HST image calibration, according to Dave Stark at STScI. “We developed a new tool to identify satellite trails that is an improvement over the previous satellite software because it is much more sensitive. So we think it will be better for identifying and removing satellite trails in Hubble images,” he said.

The tool Stark is using is based on an extensive image analysis technique called Radon Transform. It's a mathematical “trick” similar to the Fourier transform. Both can be applied to reconstruct images. And, that means the satellite tracks are not a huge threat to the telescope's continued observations - at the moment.

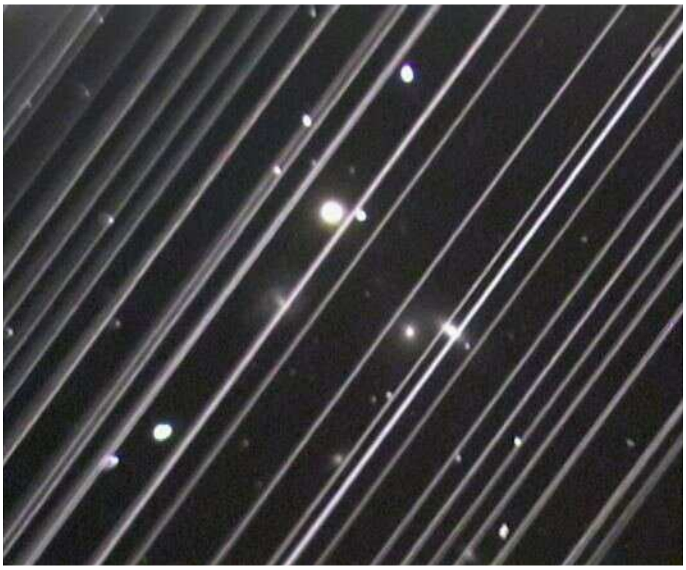
Stark applied the tool to satellite trails across Hubble's Advanced Camera for Surveys (ACS). Each Hubble science observation comes from a collection of multiple exposures on the same celestial target. A satellite crossing the field of view generally appears in one frame, and not the next consecutive frame. About ten percent of HST's observations today are affected by satellite trails.

“The average width I measured for satellites was 5 to 10 pixels,” said Stark. “The ACS's widest view is 4,000 pixels across, so a typical trail will affect less than 0.5% of a single exposure. So not only can we flag them, but they don't impact the majority of pixels in individual Hubble images. Even as the number of satellites increases, our tools for cleaning the pictures will still be relevant.”

Finding and masking satellite trails

Stark and collaborators developed a masking routine that identifies where the bad pixels are, the extent to which they affect the image, and then calls them out. “When we flag them, we should be able to recover the full field of view without a problem, after combining the data from all exposures,” said Stark.

As it stands, the software tool sums up all the light along every possible straight path across a given HST image. In this way, it identifies and characterizes linear features in an image. This approach combines all the light from a satellite trail, making it “pop out” in the transformed image. This approach works even for those that are very faint in the original image. It joins an extensive catalog of tools that astronomers have used for years to “clean up” HST observations.



An image of the NGC 5353/4 galaxy group was made with a telescope at Lowell Observatory in Arizona, USA on the night of Saturday 25 May 2019. The diagonal lines running across the image are trails of light from more than 25 Starlink satellites as they passed through the telescope’s field of view. Credit: Victoria Girgis/Lowell Observatory

What about ground-based telescopes and satellite trails?

The same satellites that plague HST give astronomers pause when it comes to observing with professional ground-based telescopes. It turns out that they can adapt to the mega-constellations. However, it's going to require quite a lot of telemetry data about those satellites. This would allow astronomers to “program around” the satellites when planning their observations. And, most facilities will need to work out similar mathematical workarounds to fix images after the fact.

Clearly, it makes a lot of sense to mitigate the effects of satellites so that they don't pose such a big challenge to astronomy. There have also been suggestions that satellite system operators try to limit the visibility of their space-based assets so that the streaks aren't so obvious.

What's the ultimate effect of those satellites on ground-based facilities? As an example, operators of the Vera C. Rubin telescope in Chile fear that at least 30% of that telescope's observations will be affected by satellite streaks. That's particularly challenging since the telescope is being built to observe everything from distant (and very faint) galaxies to potentially threatening near-Earth asteroids. The Rubin staff are working with SpaceX engineers (for example) to figure out ways to mitigate the impacts of Starlink satellites. In addition, they'll have to figure out software workarounds just as HST personnel are doing for their observations.

Guidelines to avoid satellite trails

There are some established guidelines that could help mitigate satellite trails for a wide range of facilities. In addition to darkening satellite reflectivities and providing accurate telemetry, they include keeping orbital altitudes below 600 km (to reduce the number of satellites visible later into the night), orienting reflective surfaces such as solar panels so that they don't reflect sunlight back to Earth, and reducing the numbers of satellites.

Adopting all the guidelines to mitigate satellite trails should, in theory, make imaging the night sky a bit easier for everybody, while still accommodating the growing need for the services these satellite constellations provide.

https://phys.org/news/2023-06-astronomers-figured-clever-impact-satellite.html

Astronomers “Stunned” by Discovery of Mysterious Filaments in Milky Way’s Center

Astrophysicists have discovered a new group of horizontal filaments radiating from the supermassive black hole at the center of the Milky Way. This discovery could provide more insights into the black hole’s spin and accretion disk orientation, furthering our understanding of the galaxy’s nucleus. (Artist’s concept of cosmic filaments.)

Hundreds of horizontal filaments point toward our central supermassive black hole.

- New radio telescope images reveal hundreds of filaments along the galactic plane, each measuring 5 to 10 light-years in length
- These structures likely originated a few million years ago when outflow from our supermassive black hole interacted with surrounding materials
- Researcher: “I was actually stunned when I saw these”

An international team of astrophysicists has discovered something wholly new, hidden in the center of the Milky Way galaxy.

In the early 1980s, Northwestern University’s Farhad Yusef-Zadeh discovered gigantic, one-dimensional filaments dangling vertically near Sagittarius A*, our galaxy’s central supermassive black hole. Now, Yusef-Zadeh and his collaborators have discovered a new population of filaments — but these threads are much shorter and lie horizontally or radially, spreading out like spokes on a wheel from the black hole.

Although the two populations of filaments share several similarities, Yusef-Zadeh assumes they have different origins. While the vertical filaments sweep through the galaxy, towering up to 150 light-years high, the horizontal filaments look more like the dots and dashes of Morse code, punctuating only one side of Sagittarius A*.

"It was a surprise to suddenly find a new population of structures that seem to be pointing in the direction of the black hole," Yusef-Zadeh said. "I was actually stunned when I saw these. We had to do a lot of work to establish that we weren't fooling ourselves. And we found that these filaments are not random but appear to be tied to the outflow of our black hole. By studying them, we could learn more about the black hole's spin and accretion disk orientation. It is satisfying when one finds order in a middle of a chaotic field of the nucleus of our galaxy."

An expert in radio astronomy, Yusef-Zadeh is a professor of physics and astronomy at Northwestern's Weinberg College of Arts and Sciences and member of CIERA.

Decades in the making

The new discovery may come as a surprise, but Yusef-Zadeh is no stranger to uncovering mysteries at the center of our galaxy, located 25,000 light-years from Earth. The latest study builds on four decades of his research. After first discovering the vertical filaments in 1984 with Mark Morris and Don Chance, Yusef-Zadeh along with Ian Heywood and their collaborators later uncovered two gigantic radio-emitting bubbles near Sagittarius A*. Then, in a series of publications in 2022, Yusef-Zadeh (in collaborations with Heywood, Richard Arent and Mark Wardle) revealed nearly 1,000 vertical filaments, which appeared in pairs and clusters, often stacked equally spaced or side by side like strings on a harp.

Yusef-Zadeh credits the flood of new discoveries to enhanced radio astronomy technology, particularly the South African Radio Astronomy Observatory's (SARAO) MeerKAT telescope. To pinpoint the filaments, Yusef-Zadeh's team used a technique to remove the background and smooth the noise from MeerKAT images in order to isolate the filaments from surrounding structures.

"The new MeerKAT observations have been a game changer," he said. "The advancement of technology and dedicated observing time have given us new information. It's really a technical achievement from radio astronomers."

Horizontal vs. vertical

After studying the vertical filaments for decades, Yusef-Zadeh was shocked to uncover their horizontal counterparts, which he estimates are about 6 million years old. "We have always been thinking about vertical filaments and their origin," he said. "I'm used to them being vertical. I never considered there might be others along the plane."

While both populations comprise one-dimensional filaments that can be viewed with radio waves and appear to be tied to activities in the galactic center, the similarities end there.

The vertical filaments are perpendicular to the galactic plane; the horizontal filaments are parallel to the plane but point radially toward the center of the galaxy where the black hole lies. The vertical filaments are magnetic and relativistic; the horizontal filaments appear to emit thermal radiation. The vertical filaments encompass particles moving at speeds near the speed of light; the horizontal filaments appear to accelerate thermal material in a molecular cloud. There are several hundred vertical filaments and just a few hundred horizontal filaments. And the vertical filaments, which measure up to 150 light-years high, far surpass the size of the horizontal filaments, which measure just 5 to 10 light-years in length. The vertical filaments also adorn space around the nucleus of the galaxy; the horizontal filaments appear to spread out to only one side, pointing toward the black hole.

"One of the most important implications of radial outflow that we have detected is the orientation of the accretion disk and the jet-driven outflow from Sagittarius A* along the galactic plane," Yusef-Zadeh said.

'Our work is never complete'

The new discovery is filled with unknowns, and Yusef-Zadeh's work to unravel its mysteries has just begun. For now, he can only consider a plausible explanation of the new population's mechanisms and origins.

"We think they must have originated with some kind of outflow from an activity that happened a few million years ago," Yusef-Zadeh said. "It seems to be the result of an interaction of that outflowing material with objects near it. Our work is never complete. We always need to make new observations and continually challenge our ideas and tighten up our analysis."

https://scitechdaily.com/astronomers-stunned-by-discovery-of-mysterious-filaments-in-milky-ways-center/

How Soon Will Betelgeuse Blow?

A new study making the rounds predicts that supergiant Betelgeuse will explode as a supernova sooner rather than later, but others are urging caution.

The roiling surface of Betelgeuse This artist's impression shows the supergiant star Betelgeuse. ESO / L. Calçada

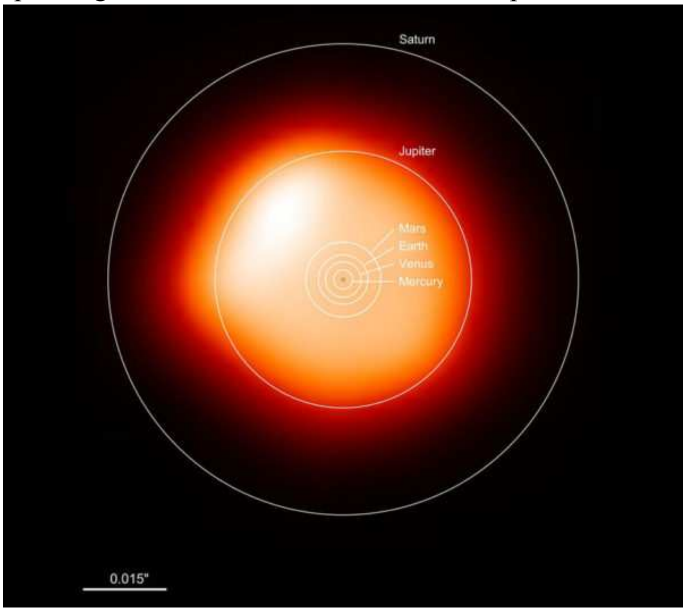
If astronomers had to guess the next, nearby star to go supernova in the Milky Way, their bets might go to Betelgeuse. The bright-red supergiant star that marks Orion's shoulder is nearing the end of its life, and it's less than 1,000 light-years from Earth. But how close is it to going supernova? And will we be around to see it?

Typically, astronomers suggest it might explode within the next 100,000 years — that is, "soon" on a cosmic timeframe, not a human one. But a new study posted June 1st on the arXiv has been making the rounds, in which Hideyuki Saio (Tohoku University, Japan) and colleagues claim that the star might be further along in its evolution, and that much closer to exploding, than we thought. However, others are taking issue with that result.

The claim comes down to the star's pulsations. Betelgeuse is unstable, "breathing" in and out regularly, with overlapping overtones. Following its brightness over the past century (thanks in part to data from the American Association for Variable Star Observers), astronomers have noted changes over periods of 2,200 days, 420 days, 230 days, and 185 days.

Usually, astronomers treat the 420-day up-and-down as the primary in-and-out pulsation, with the shorter cycles as overtones. The 2,200-day (or 6-year) period isn't generally considered part of these ins and outs, and is instead dubbed a long secondary period, a feature of unknown origin common to one-third of supergiant stars.

If the 420-day period is the primary one, then Betelgeuse would have the diameter of 800 to 900 Suns lined up in a row. Placed in the solar system, it would almost reach the orbit of Jupiter. Saio and colleagues, however, think that might be an underestimate. If the 2,200-day cycle is the primary one, and all the rest are overtones, then the star would be even more supergiant, spanning 1,200 Suns — even wider than Jupiter's orbit.



This image, made with the Atacama Large Millimeter/ submillimeter Array (ALMA), shows the red supergiant Betelgeuse placed at the center of our solar system. This shows one estimate of the star's size, which isn't yet well understood.ESO

In line with its larger size, the star would be even further along in its lifecycle. Stars like Betelgeuse live fast and large. Like the Sun, they first light up by fusing hydrogen into helium within their cores, but they quickly move on to helium, fusing it into carbon. Carbon then burns to make other, heavier elements. Around the core, lighter elements burn in shells, causing the star to billow outward like a hot plasma balloon.

Saio and his colleagues use computer simulations to watch stars evolve from birth to old age, then they calculate the pulsations they ought to see at each stage. They find that all four pulsations — from the 2,200-day cycle through the 185-day cycle — can be explained by a "breathing" star in the late stages of carbon-burning. "After carbon is exhausted in the core, a core-collapse leading to a supernova explosion is expected in a few tens years," the researchers write.

But when will the carbon run out? It's hard to tell because the pulsation periods don't change much at this late stage. "It's not possible to exactly estimate how much carbon is left in the core at present," Saio says. "We just guess the time to the carbon exhaustion is probably less than a few hundred years."

So, to put some headlines in perspective, Saio's group isn't saying Betelgeuse will blow tomorrow or even in the next decade. The researchers' claim is that Betelgeuse would blow within 1,000 years rather than 10,000 or 100,000.

Notes of Caution

Other researchers are expressing qualms about the new calculations. Morgan MacLeod (Center for Astrophysics, Harvard & Smithsonian), a theorist who studies pulsating stars, says the new results don't mesh with other observations of the star. The problem with taking the 2,200-day cycle to be part of Betelgeuse's "breathing" is that it makes the supergiant too giant.

Betelgeuse is so big and so nearby that we can compare the size estimate from Saio's team to actual interferometric measurements of its diameter. Saio's team quotes several of these measurements, each of which finds a larger size between 1,000 and 1,500 times the Sun's girth.

However, these are all taken at infrared wavelengths. Stars aren't solid objects, and different wavelengths penetrate to different depths. Visible-light observations, which penetrate to the visible surface (or photosphere), give a smaller size. "The sizes mentioned in the paper (55 milli-arcseconds) are measured at several microns," MacLeod says, "and are larger than the optical photosphere size of about 42 milli-arcseconds." László Molnár and colleagues detail this contradiction further in the Research Notes of the AAS.

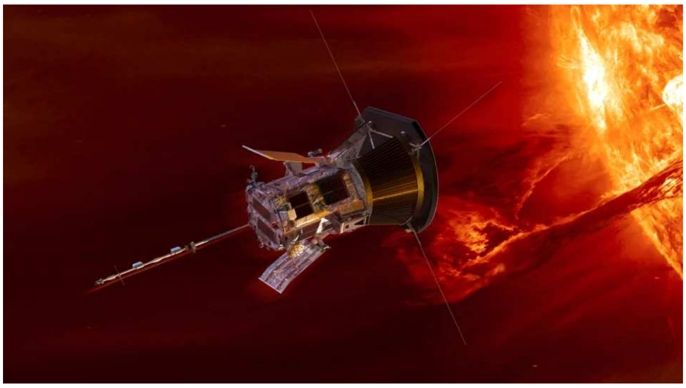
The 2,200-day pulsation, if radial, creates other problems, too. Spectroscopic measurements show that the star's surface expands and contracts at some 1.5 kilometers per second. If the star is "breathing" at this rate over the span of 2,200 days, its total diameter would be changing by 180 times the Sun's size every cycle. Even for astronomers, that's a lot.

What's more, the 2,200-day pulsation would also affect the pulsation of the overtones. So, for example, the 400-day cycle wouldn't always be 400 days. When the star puffs out to its full size, this overtone would lengthen; likewise, when the star shrinks, it would shorten. "These changes would be expected to repeat systematically every 2,200-day cycle," MacLeod says, "and I don't think we see evidence for that in Betelegeuse's long-term light curve, which varies more randomly around the 400-day typical cycle."

"I think the interpretation presented by Saio and colleagues isn't at all ruled out," he adds. "But there are some potential questions that it raises, that, at face value, seem in tension with what the data indicate."

https://skyandtelescope.org/astronomy-news/how-soon-will-betelgeuse-blow/

First mission to "touch" the sun catches the solar wind



Parker Solar Probe as it approaches the sun.

A solar mission that has been spiraling closer to the sun to unravel its secrets has flown near enough to our star's surface to make a key discovery.

Data from the Parker Solar Probe has uncovered the source of solar wind, a stream of energized particles that flow from the corona, or the sun's hot outer atmosphere, toward Earth.

One of the key motivations behind the mission, named for the late astrophysicist Eugene Parker and launched in 2018, was to determine what the wind looks like as it forms near the sun and how it escapes the star's gravity.

As the probe came within about 13 million miles (20.9 million kilometers) of the sun, its instruments detected fine structures of the solar wind where it generates near the photosphere, or the solar surface, and captured ephemeral details that disappear once the wind is blasted from the corona.

The spacecraft was specially designed to eventually fly within 4 million miles (6.4 million kilometers) above the solar surface, and in late 2021, it became the first mission to "touch" the sun.

A study detailing the solar findings was published Wednesday in the journal Nature.

Untangling solar wind

Solar wind is a continuous outflow of plasma, which contains charged particles like protons and electrons. The far-reaching phenomenon also includes part of the solar magnetic field and extends well beyond the corona, interacting with planets and the interstellar medium.

There are two types of this wind. The faster solar wind streams from holes in the corona at the sun's poles at a peak speed of 497 miles per second (800 kilometers per second). The slower solar wind, located in the same plane of the solar system as Earth, flows at a calmer 249 miles per second (400 kilometers per second).

The fast solar wind doesn't usually impact Earth. But during the maximum of the solar cycle, an 11-year period over which the sun's activity gradually increases, the sun's magnetic field flips. This flip causes the coronal holes to appear across the sun's surface and release bursts of solar wind directly toward Earth.

Understanding the source of the solar wind can help scientists better predict space weather and solar storms that can affect Earth.

Although they can cause beautiful auroras, the solar storms can also impact satellites and Earth's electrical grids.

"Winds carry lots of information from the sun to Earth, so understanding the mechanism behind the sun's wind is important for practical reasons on Earth," said study coauthor James Drake, distinguished professor of physics at the University of Maryland, College Park, in a statement. "That's going to affect our ability to understand how the sun releases energy and drives geomagnetic storms, which are a threat to our communication networks."

The spacecraft's data revealed that the coronal holes act like showerheads, where jets appear on the sun's surface in the form of bright spots, marking where the magnetic field passes in and out of the photosphere.

As magnetic fields pass each other, moving in opposite directions within these funnels on the solar surface, they break and reconnect, which sends charged particles flying out of the sun.

"The photosphere is covered by convection cells, like in a boiling pot of water, and the larger scale convection flow is called supergranulation," said lead study author Stuart D. Bale, a professor of physics at the University of California, Berkeley, in a statement.

"Where these supergranulation cells meet and go downward, they drag the magnetic field in their path into this downward kind of funnel. The magnetic field becomes very intensified there because it's just jammed. It's kind of a scoop of magnetic field going down into a drain. And the spatial separation of those little drains, those funnels, is what we're seeing now with solar probe data."

Parker Solar Probe detected highly energetic particles traveling between 10 and 100 times faster than the solar wind, leading the researchers to believe that the fast solar wind is created by the reconnection of magnetic fields.

"The big conclusion is that it's magnetic reconnection within these funnel structures that's providing the energy source of the fast solar wind," Bale said. "It doesn't just come from everywhere in a coronal hole, it's substructured within coronal holes to these supergranulation cells. It comes from these little bundles of magnetic energy that are associated with the convection flows. Our results, we think, are strong evidence that it's reconnection that's doing that."

The solar cycle

The sun is expected to reach solar maximum in July 2025, which is why there have been increasing reports of solar flares and the northern and southern lights being visible in unexpected places. Fortunately, Parker Solar Probe and a separate mission, Solar Orbiter, are perfectly poised to observe the sun's powerful, dynamic forces at play.

But scientists are grateful that Parker Solar Probe launched ahead of the sun's increasing dramatics during the quieter solar minimum, when chaotic activity didn't have a chance of obscuring observations.

"There was some consternation at the beginning of the solar probe mission that we're going to launch this thing right into the quietest, most dull part of the solar cycle," Bale said. "But I think without that, we would never have understood this. It would have been just too messy. I think we're lucky that we launched it in the solar minimum."

https://edition.cnn.com/2023/06/07/world/parker-solar-probe-solar-wind-scn/index.html

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Galactic Archaeology

A review of "The Ins and Outs of the Milky Way"

The VAS public talk for May 2023 by Professor Sean Ryan

Do we ever look up at the night sky and think how the view is never-changing, except for the wandering planets against a timeless backdrop of the "fixed stars"? In our May talk, Prof. Sean Ryan showed us a wide perspective in time and space and demonstrated how even the galaxies of billions of stars are constantly in motion, constantly interacting and evolving. Far from being a timeless backdrop, the Milky Way is a cauldron of flux and change.

Figure 1 - A southern hemisphere view of part of the Milky Way and the two Magellanic Clouds, seen from Chile (Credit: ESO / Y. Beletsky)

Sean has been Professor of Astrophysics at the University of Hertfordshire for 17 years and before that worked on several exciting projects around the world. But he also has decades of experience as a keen amateur observer, going back to his roots in Christchurch, New Zealand. Even with the naked eye, the view of the Milky Way from the southern hemisphere provides clues about the nature of our Galaxy: most stars are concentrated in a narrow band; the Milky Way wraps around the whole sky (so we are inside this structure); there is a brighter concentration in one direction (so we are not at the centre); not everywhere is bright (there is dark stuff - dust); and there are separate concentrations of stars (the Magellanic Clouds, companion galaxies - so we are not alone). And with binoculars one can map out a halo of globular clusters around the centre of the Milky Way.

But to really get to grips with the history and changing structure of our Galaxy, we need more measurements: various methods give us the distances to stars, clusters and galaxies, and along with angular and radial motion, this provides velocities - everything is moving - and through study of spectra we can assess what distant stars are made of. Great work from the beginning of the 20th century gives methods for estimating the age of populations of stars. These are the tools of what Sean terms "galactic archaeology".

There is a galaxy far, far away… about 1.6 million light years away in fact, called NGC6822, and this is central to Sean's archaeological tale. It was first discovered by E E Barnard in 1884 in the constellation of Sagittarius. Then nearly 100 years ago in 1925, Edwin Hubble identified it as "the first object assigned outside of the galactic system". Sean introduced an entertaining analogy here: mice are a perennial problem for observatories, but the question is, if you see ONE mouse, how many others are out there? Similarly, if you see ONE satellite galaxy, how many others are out there…?

Figure 2 - NGC6822 in Sagittarius (Credit: ESO / wikimedia)

Most of the rest of Sean's talk took us on a whirlwind tour of the galactic archaeological discoveries of the next 100 years. It could have been a blur of dates and names and ideas, but in the hands of an expert teacher we saw a developing picture of galaxies and dwarf galaxies passing close to each other, causing distortions, leaving tell-tale streams of stars with similar motions, giving rise to galactic spirals and saucer-like bulges.

We heard about:

- Nancy Roman in the 1940s and 50s identifying the first connected stream of stars with the same motion in Ursa Major
- Various researchers in the 1960s finding fast moving populations of stars that formed outside of the Milky Way, but "fell into" the main disk of stars
- In the 1970s there were the first pioneering computer simulations of galaxy formation, which showed the persuasive possibilities of spiral-like structures coming about from interaction with

nearby galaxies; and in 1974 was the first direct observation of a tell-tale filament structure (a stream of stars) that joined the Magellanic Clouds to the Milky Way

- In the 1980s the fall of dwarf satellite galaxies through the Milky Way was related to characteristic orbital periods of some star populations

The stunning finale of this presentation was a computer simulation which ran from the Big Bang, through initial Galaxy formation and then the dynamic whirl of dwarf galaxies coming and going, leaving traces of their path in the present-day structures of the Galaxy. This amazing work is being done by Sean's colleague Prof. Chiaki Kobayashi at the University of Hertfordshire. (The links to this and other astronomical simulations can be found on her home page at: CHIAKI's Research (herts.ac.uk) *https://www.star.herts.ac.uk/~chiaki/research-e.html* - well worth a visit!)

Figure 3 - Chiaki Kobayashi (University of Hertfordshire), at the frontline of modern cosmology

Meticulous observations and ingenious theory, combined with cutting-edge computer simulations, have convincingly pieced together the encounters between our near-neighbours in the Local Group of galaxies (did you know there are at least 80 members, mostly dwarf galaxies? That's a lot of mice!)

And what about that first “mouse”, NGC6822? Further study has revealed even more about it: by characterising different populations of stars (oxygen-rich versus carbon-rich) a distribution of star velocities shows that there is a systemic rotation. So even in this small, relatively isolated galaxy, there is evidence of a complex dynamic history. Next time you look up at the night sky, remember that we are not seeing an eternal unchanging backdrop, but a seething mass of motion and interaction, an astronomically slow cosmic dance.

This review of the May talk was prepared by Simon Gardner. If you have any feedback on the monthly public talks, topics you would like to see more or less of, or speakers that you could recommend, please contact Simon at progorg@wightastronomy.org

Water, water everywhere, including the icy moons of Uranus

Oceans of water hidden beneath the frozen crusts of large moons orbiting Jupiter, Saturn and other icy bodies in the outer solar system are a hot topic in planetary astronomy, with NASA and the European Space Agency both sending probes to Jupiter to look for evidence of habitable sub-surface environments.

Now add Uranus to the mix.

Re-analysis of data collected by NASA’s Voyager 2 spacecraft, along with advanced computer modelling, suggests that four of Uranus’ largest moons – Ariel, Umbriel, Titania and Oberon – may harbour oceans dozens of miles below their frigid surfaces.

“When it comes to small bodies – dwarf planets and moons – planetary scientists previously have found evidence of oceans in several unlikely places, including the dwarf planets Ceres and Pluto, and Saturn’s moon Mimas,” said Julie Castillo-Rogez, a Jet Propulsion Laboratory researcher and lead author of a paper in the Journal of Geophysical Research.

“So there are mechanisms at play that we don’t fully understand. This paper investigates what those could be and how they are relevant to the many bodies in the solar system that could be rich in water but have limited internal heat.”

The study incorporates data collected by Voyager and computer models using data from the Galileo Jupiter orbiter, the Dawn asteroid mission and the New Horizons flyby of Pluto and its moon Charon, along with insights provided by the Cassini probe’s study of Saturn’s moon Enceladus.

The modelling helped researchers determine the porosity of the surfaces of Uranus’ moons, which indicates they are likely insulated enough to retain the heat needed for liquid oceans to exist beneath the surface.

That heat may be provided by radioactive decay, but the study also suggests chlorides, as well as ammonia, are likely to be abundant, serving as a sort of antifreeze. But many questions remain and more work is needed to hammer out the details.

“We need to develop new models for different assumptions on the origin of the moons in order to guide planning for future observations,” said Castillo-Rogez.

https://astronomynow.com/2023/05/10/water-water-everywhere-including-the-icy-moons-of-uranus/

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LINKS, COMMENTS AND OBSERVATIONS

June Monthly Meeting Login Details

Online Zoom Meeting

Stellar Evolution - The life cycle of a star and its implications for life in our Solar System

By

Dr. Elizabeth Cunningham

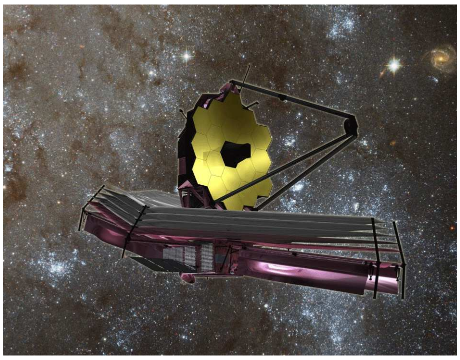
Time: June 23, 2023 19:30 PM

Join Zoom Meeting Link

https://us02web.zoom.us/j/87523576773?pwd=MmVQQ3RGaHFZck5aUlRvL1ZKTXNPdz09

Zoom Meeting code and password
Meeting ID: 875 2357 6773
Passcode: unemaZP10_

James Webb Telescope - Live Updates



NASA's James Webb Space Telescope, the agency's successor to the famous Hubble telescope, launched on Dec. 25, 2021 on a mission to study the earliest stars and peer back farther into the universe's past than ever before.

Webb is currently at its observing spot, Lagrange point 2 (L2), nearly 1 million miles. It is the largest and most powerful space telescope ever launched.

Space.com is sharing live updates about the new space observatory's mission.

https://www.space.com/news/live/james-webb-space-telescope-updates

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

Earth is 18 galactic years old. One galactic year is the amount of time it takes for the Milky Way to rotate around the black hole at its center - which is equivalent to about 230 earth-years

The distance between the moon and Earth is always growing; the moon moves about 3.8 centimeters further away every year

Phytoplankton, which live in the ocean, use photosynthesis to produce half of the earth's oxygen

Jellyfish have existed on earth for over half a billion years

Early human ancestors used to have three eyelids, one of which eventually became the small fold in the corner of human eyes today

Blue, green, and hazel eyes all exist thanks to a genetic mutation; brown was the only eye color present in humans until about 6,000 years ago

Human beings, like all carbon-based life forms, are made from the dust of dying stars