WASNEWS

Volume31 Issue 1

Sept 2024

Newsletter for the Wiltshire, Astronomical Society

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Changes and New Brooms

This may well be my last newsletter for a while, I away at the month ends/ beginnings in October, November and December.

I have been trying to step back as chair for 6 years but at last, after 14 years I can hand back the reigns to Simon Barnes who has returned to the UK.

I want to take the opportunity to thank the people who have helped in many rolls through the last 19 years. Before this I did 9 years as Vice Chair person..

In the last 310 meetings I only missed one when my dear wife died whilst we were in Spain with members of the society visiting the observatory there.

Membership has changed its attendance particularly since Covid and establishing a split between Zoom meetings and attended meetings with speaker in the hall was necessary to protect the society as a financially viable entity. Speakers became more expensive as travel prices climbed in the last 4 years and numbers dropped below basic hall cost minimum cover charges.

But looking at the accounts for the year I am pleased to report we are still above the emergency funding minimum. FAS fees have been rising slightly too, but the public liability insurance has been critical for the society and way cheaper than anything we could arrange for ourselves.

I hope the society can continue to support members unable to attend meetings as well as those who can attend, and also develop its successful observing sessions.

Enough from me, I have seen the glistening blades in the well gas lighted area in the e-mail behind my back.

Clear Skies and good luck

Andy Burns.

Ps After 30 years of writing and editing the newsletter does anyone else want a go? Try it for 3 months while I am not available?

This summer has been horrible for viewing over all, but when it has cleared we have been rewarded with phenomenal experiences. Here on the 11/12th August the usual evening for the Perseid meteor shower we were also rewarded in theearly hours with another Aurora Borealis!

Taken from my upstairs window at around 1:20pm on the 12th. A Perseid graces the north eastern skies, while the aurora covers the north.

Andy Burns

Volume25, Issue9

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

Facebook members page: https://www.facebook.com/groups/wiltshire.astro.society/

Meetings 2023

HALL VENUE the Pavilion, Rusty Lane, Seend

Some Speakers have requested Zoom Meetings will be stay at home sessions.

Meet 7.45 for 8.00pm start

SEASON 2023/24

2024

Sept 3rd AGM and members evening. In the hall.

Tonight AGM and members meeting.

Membership Meeting nights £1.00 for members £3 for visitors

Members can renew or new members sign up online via https://wasnet.org.uk/membership/ and also remind them they can pay in cash too on the door.

Wiltshire AS Contacts

Chairperson:

Outreach coordinator:

Newsletter/Publicity

Treasurer and Membership: Sam Franklin

Hall coordinator:

Live Meeting Supplies

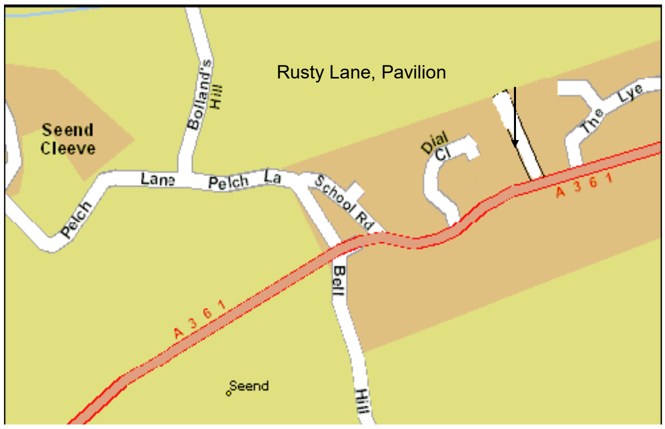
Speaker secretary

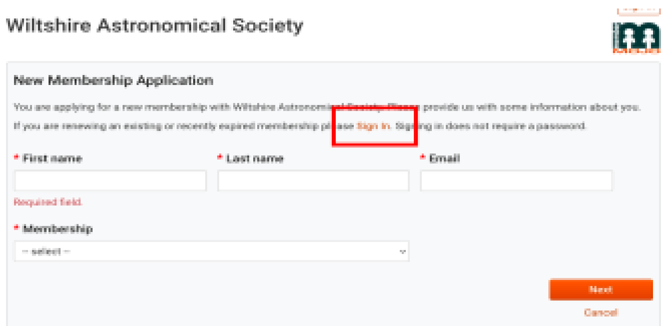
Zoom session coordinator

Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.




Wiltshire Astronomical Society

New Membership Application

You are applying for a new membership with Wiltshire Astronomical Society. Please provide us with some information about you.
If you are renewing an existing or recently expired membership please Sign In. Signing in does not require a password.

* First name | * Last name | * Email

Required field.

* Membership

-- select --

Next

Cancel

Observing Sessions see back page

Swindon's Own Astronomy Group

Physical meetings

The club meets in person once per month.

Online Meetings

Once per month to discuss equipment and techniques.

Ad-hoc viewing sessions

Regular stargazing evenings are organised near Swindon. The club runs a WhatsApp group to notify members in advance of viewing sessions, usually at short notice. Anyone can call a viewing. To join these events please visit our website.

Information about our evenings and viewing spots can be found below:

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

Meetings at Liddington Village Hall
Church Road, Liddington, SN4 0HB
7.30pm onwards

The hall has easy access from Junction 15 of the M4, a map and directions can be found at:
http://www.swindonstargazers.com/clubdiary/directions01.htm

Following Meeting Dates

Friday, 20 September 2024 @ 19:30

Owen Brazell: Choosing an Eyepiece – it is half the telescope

Friday, 18 October 2024 @ 19:30

Prof Martin Hendry MBE - The Science of Star Wars

Friday, 18 October 2024 @ 19:30

Prof David Southwood CBE: How and why the Icy Moons of Jupiter became a goal for space exploration?

Website:
http://www.swindonstargazers.com

Chairman: Damian OHara
Email: swindonstargazers@duck.com

Secretary: Hilary Wilkey
Email: hilary@wilkey.org.uk
Address: 61 Northern Road
Swindon, SN2 1PD

BATH ASTRONOMERS

A friendly community of stargazers and enthusiastic astronomers who share experiences and know-how and offer an extensive outreach programme of public and young people's observing and activities. As a partner of Bath Preservation Trust and the Herschel Society, Bath Astronomers are the resident astronomers at the Herschel Museum of Astronomy. Bath Astronomers also operate a 5-metre mobile planetarium taking it to schools and community events to show off the night sky even when the clouds hide the starry sky.

Contact us using hello@bathastronomers.org.uk

Members:

Over 136 members enjoy free monthly talks, free access to the Herschel Museum, astronomy WhatsApp groups and free telescope loans. https://bathastronomers.org.uk/membership/ shows the benefits and annual subscription fees.

Next Gatherings:

Wednesday, **25th September 2024** – Talk by **Prof. Catherine Heymans**, Astronomer Royal for Scotland

Wednesday, **30th October 2024** – Talk by **Prof. Chris Lintott**, Gresham Professor of Astronomy. To be held at BRLSI.

Wednesday, **27th November 2024** – AGM, new starters, and photo exhibition. To be held at BRLSI.

Wednesday, **11th December 2024** – Talk by **Meyrick Williams** on planetary weather.

Gatherings are held on the last Wednesday of each month at 7:30pm (excluding December, July, and August) and are of 90 minutes duration or so.

Venue for Gatherings:

Unless otherwise specified, meetings are held at the Herschel Museum of Astronomy, 19 New King Street, Bath, BA1 2BL.

The Team:

Chair: Simon Holbeche

Treasurer: Julia Matthews

Coordinators: Martin Farrell, Meyrick Williams, Prim Pike

Outreach Guru: Camilla Evans

Shared Stargazing:

Public stargazing is scheduled twice a month on Friday or Saturday evenings to promote astronomy in Bath and Somerset area. Locations vary to bring telescopes to local communities. Members' observing is conducted from the Monkton Combe Community Observatory using the Victorian refractor and more modern telescopes. We try to avoid school nights but will run member's sessions when the clouds look like they'll recede long enough to align a Goto telescope.

Public Solargazing is also scheduled when the weather permits with pop-up events at locations all over Bath to increase access. The society has a range of solar telescopes that are safe to share the Sun's surface with.

Outreach:

Bath Astronomers are very active providing stargazing, workshops and talks for the local community, schools, and young peoples' organisations. Planetarium shows, rocket launching, and night sky experiences. The offerings include the Discover Astronomy Loan Box, a flight case full of astronomy goodies for teachers and the classroom available for no charge.

Sat 7th Sept – Wellow Village Show Solargazing
Sun 8th Sept – Members' Solargazing
Sun 8th Sept – Opposition of Saturn Solargazing
Sat 14th Sept – Bathampton Village Show
Mon 23rd Sept – Freshers' Night Stargazing
Mon 23rd Sept – Autumnal Equinox at the Museum
Wed 2nd Oct – 100Hours Stargazing
Fri 4th Oct – 100Hours Stargazing
Sat 5th Oct – 100Hours Stargazing

Visit https://stem.bathastronomers.org.uk/ for more.

Video channel for BA adventures:

https://www.youtube.com/@bathastronomers

Web & Social Media links:

https://bathastronomers.org.uk

https://www.instagram.com/bathastronomers

https://bsky.app/profile/bathastronomers.org.uk

https://www.facebook.com/BathAstronomers

https://www.threads.net/@bathastronomers

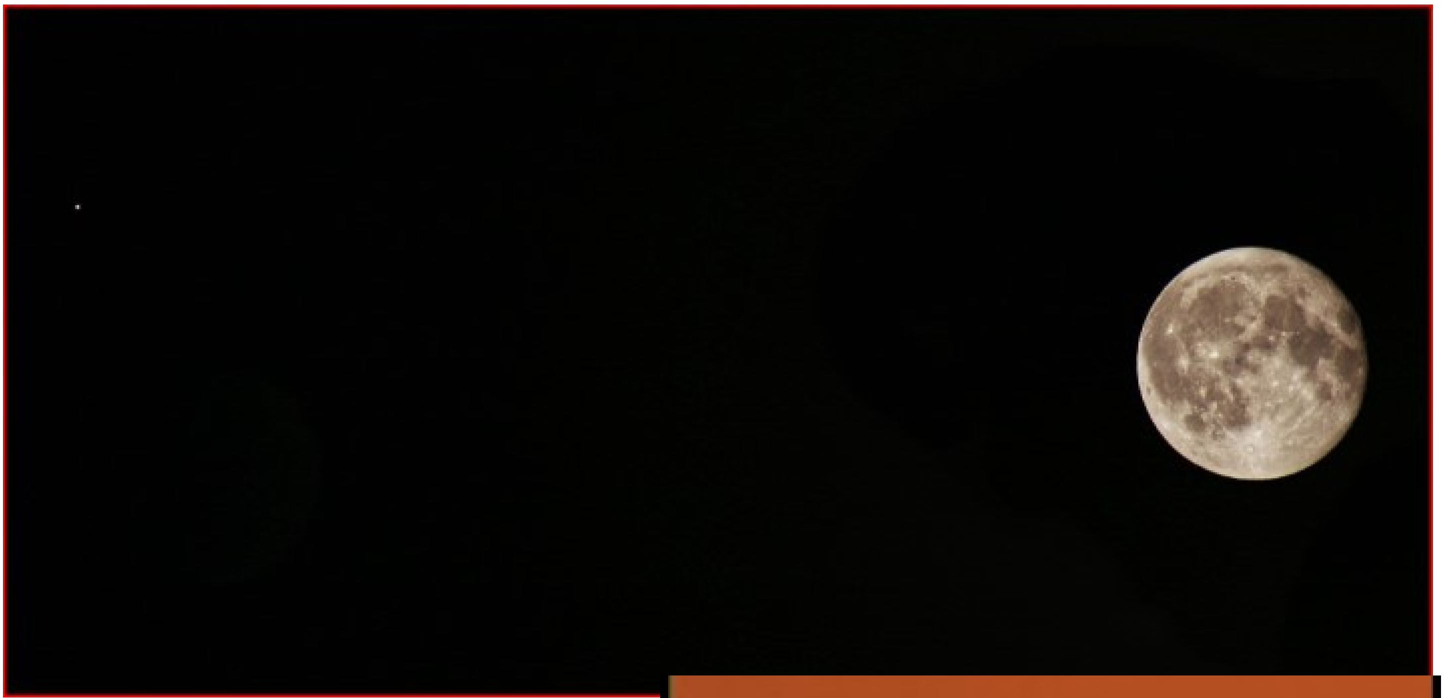
https://mastodonapp.uk/@bathastronomers

https://twitter.com/bathastronomers

E Mails,Viewing Logs and Members Images

From Peter Chappell.

Saturn and the Moon, and solar images using SkyScan.



SPACE NEWS

Space News for September 24

China's first Mars global color image map. Credit and ©: Science China Press

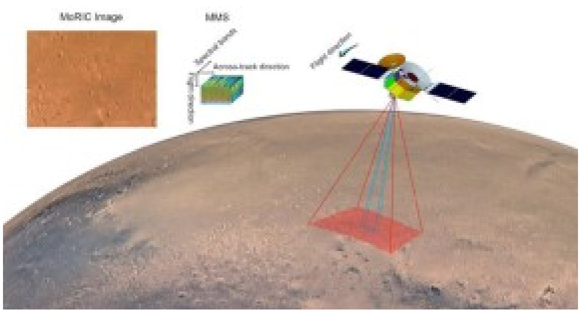
Posted onSeptember 1, 2024 by Matt Williams

A Global Colour Map of Mars, Courtesy of China's Tianwen-1 Mission

In July 2020, China's *Tianwen-1* mission arrived in orbit around Mars, consisting of six robotic elements: an orbiter, a lander, two deployable cameras, a remote camera, and the *Zhurong* rover. As the first in a series of interplanetary missions by the China National Space Administration (CNSA), the mission's purpose is to investigate Mars's geology and internal structure, characterize its atmosphere, and search for indications of water on Mars. Like the many orbiters, landers, and rovers currently exploring Mars, Tianwen-1 is also searching for possible evidence of life on Mars (past and present).

In the almost 1298 days that the Tianwen-1 mission has explored Mars, its orbiter has acquired countless remote-sensing images of the Martian surface. Thanks to a team of researchers from the Chinese Academy of Sciences (CAS), these images have been combined to create the first high-resolution global color-image map of Mars with spatial resolutions greater than 1 km (0.62 mi). This is currently the highest-resolution map of Mars and could serve as a global base map that will support crewed missions someday.

The team was led by Professor Li Chunlai from the National Astronomical Observatories of China (NOAC) and Professor Zhang Rongqiao from the Lunar Exploration and Space Engineering Center. They were joined by multiple colleagues from the Key Laboratory of Lunar and Deep Space Exploration, the Institute of Optics and Electronics, the University of Chinese Academy of Sciences, and the Shanghai Institute of Technical Physics. The paper detailing their research, "A 76-m per pixel global color image dataset and map of Mars by Tianwen-1," recently appeared in the journal *Science Bulletin*.



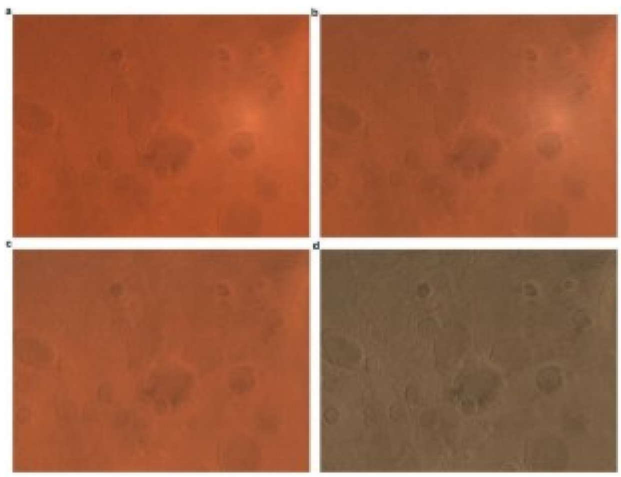
The optical camera (MoRIC) and imaging spectrometer (MMS) onboard the Tianwen-1 orbiter were used to obtain remote-sensing images of the entire Martian surface. Credit and ©: Science China Press

Several global maps of Mars have been created using remote-sensing images acquired by instruments aboard six previous missions. These include the visual imaging systems of the *Mariner 9* probe, the *Viking 1* and *2* orbiters, the Mars Orbiter Camera-Wide Angle (MOC-WA) aboard the *Mars Global Surveyor* (MGS), the Context Camera (CTX) aboard the *Mars Reconnaissance Orbiter* (MRO), the High-Resolution Stereo Camera (HRSC) of *Mars Express* (MEX), and the Thermal Emission Imaging System (THEMIS) on the *Mars Odyssey* orbiter.

However, these maps all had a spatial resolution significantly less than what the CAS team created using images acquired by the *Tianwen-1* orbiter. For example, the MGS MOC-WA Atlas Mosaic has a spatial resolution of 232 meters per pixel (280 yards per pixel) in the visible band, and the THEMIS Global Mosaic of the Mars Odyssey mission offers a spatial resolution of approximately 100 m/pixel (~110 ft/pixel) in the infrared band. While the MRO Global CTX Mosaic of Mars covered 99.5% of the Martian surface (88° north to 88° south) in the visible band, it has a spatial resolution of about 5 m/pixel (5.5 yards/pixel).

There has also been a lack of global color images of Mars with spatial resolutions of a hundred meters (110 yards) or higher. In terms of global color images, the Mars Viking Colorized Global Mosaic v1 and v2 have spatial resolutions of approximately 925 m/pixel and 232 m/pixel (~1010 and 255 yards/pixel), respectively. Meanwhile, the MoRIC instrument acquired 14,757 images during the more than 284 orbits executed by the Tianwen-1 orbiter, with spatial resolutions between 57 and 197 m (62 and 215 yards).

During this same time, Tianwen-1's Mars Mineralogical Spectrometer acquired a total of 325 strips of data in the visible and near-infrared bands, with spatial resolutions varying from 265 to 800 m (290 to 875 yards). The collected images also achieved global coverage of the Martian surface. Using this data, Professor Li Chunlai, Professor Zhang Rongqiao, and their colleagues processed the image data that led to this latest global map of Mars. The team also optimized the original orbit measurement data using bundle adjustment technology.



(a) Level 2C data product as the input, (b) image corrected by atmospheric correction, (c) image corrected by photometric correction, and (d) image corrected after color correction. Credit and ©: Science China Press

By treating Mars as a unified adjustment network, the team was able to reduce the position deviation between individual images to less than 1 pixel and create a "seamless" global mosaic. The true colors of the Martian surface were achieved thanks to data acquired by the MMS, while color correction allowed for global color uniformity. This all culminated with the release of the Tianwen-1 Mars Global Color Orthomosaic 76 m v1, which has a spatial resolution of 76 m (83 yards) and a horizontal accuracy of 68 m (74 yards).

This map is currently the highest-resolution true-color global map of Mars and significantly improves the resolution and color authenticity of previous Mars maps. This map could serve as a geographic reference for other space agencies and partner organizations to map the Martian surface with even greater resolution and detail. It could also be used by space agencies to select sites for future robotic explorers that will continue searching for clues about Mars' past. It could also come in handy when NASA and China send crewed missions to Mars, which are slated to commence by the early 2030s or 2040s.

Further Reading: Eureka Alert!, Science Bulletin

Image of Earth from 2020, over the South Pacific Ocean from the EPIC camera on the DSCOVR satellite. Many things affect Earth's albedo, including clouds, snow cover, and vegetation. How does exoplanet vegetation affect albedo and climate? Credit: NASA/NOAA

Posted onAugust 30, 2024 by Evan Gough

How Vegetation Could Impact the Climate of Exoplanets

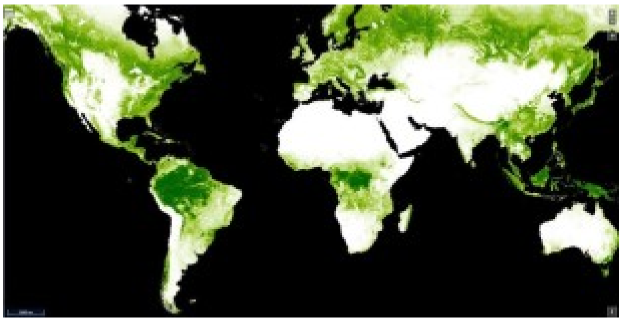
The term 'habitable zone' is a broad definition that serves a purpose in our age of exoplanet discovery. But the more we learn about exoplanets, the more we need a more nuanced definition of habitable.

New research shows that vegetation can enlarge the habitable zone on any exoplanets that host plant life.

Every object in a solar system has an albedo. It's a measurement of how much starlight the object reflects back into space. In our Solar System, Saturn's moon, Enceladus, has the highest albedo because of its smooth, frozen surface. Its albedo is about 0.99, meaning about 99% of the Sun's energy that reaches it is reflected back into space.

There are many dark objects in space with low albedoes. Some say that another of Saturn's moons, Iapetus, has the lowest albedo.

Earth, the only living planet, has an albedo of about 0.30, meaning it reflects 30% of the Sunlight that reaches it back into space. Many factors affect the albedo. Things like the amount of ice cover, clouds in the atmosphere, land cover vs ocean cover, and even vegetation all affect Earth's albedo.



This image made of satellite data shows the regions of Earth covered by forests with trees at least five meters (16.5 ft.) tall. Image Credit: NASA/LandSat

We live in an age of exoplanet discovery. We now know of more than 5,000 confirmed exoplanets, with many more on the way. Though all planets are interesting scientifically, we're particularly interested in exoplanets that are potentially habitable.

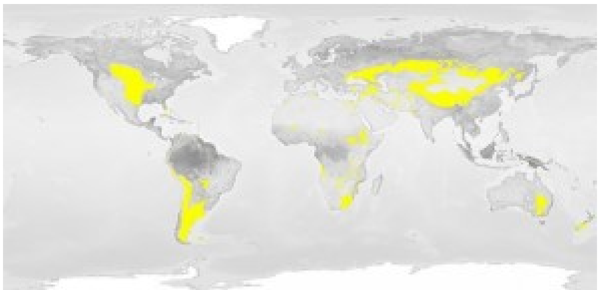
A team of Italian researchers is examining exoplanet habitability through the lens of vegetation and albedo. Their work is in a paper to be published in the Monthly Notices of the Royal Astronomical Society titled "Impact of vegetation albedo on the habitability of Earth-like exoplanets." The lead author is Erica Bisesi, a Postdoctoral Researcher at the Italian National Institute for Astrophysics' Trieste Astronomical Observatory.

"Vegetation can modify the planetary surface albedo via the Charney mechanism, as plants are usually darker than the bare surface of the continents," the researchers write in their paper. Compared to a dead planet with bare continents, an exoplanet with vegetation cover should be warmer if they're both the same distance from similar stars.

The Charney mechanism is named after Jule Charney, an American meteorologist who is considered by many to be the father of modern meteorology. It's a feedback loop between vegetation cover and how it affects rainfall.

In their work, the researchers updated the Earth-like Surface Temperature Model to include two types of dynamically competing vegetation: grasslands and forests, with forests included in the seedling and mature stages.

"With respect to a world with bare granite continents, the effect of vegetation-albedo feedback is to increase the average surface temperature," the authors explain. "Since grasses and trees exhibit different albedos, they affect temperature to different degrees."



On Earth, grasslands are found on every continent except Antarctica. They're one of the largest biomes on Earth. Image Credit: NASA Earth Observatory

Since grasses and trees affect albedo differently, vegetation's effect on planetary albedo is linked to the outcome of their dynamic competition. "The change in albedo due to vegetation extends the habitable zone and enhances the overall planetary habitability beyond its traditional outer edge," the authors write.

The researchers considered four situations:

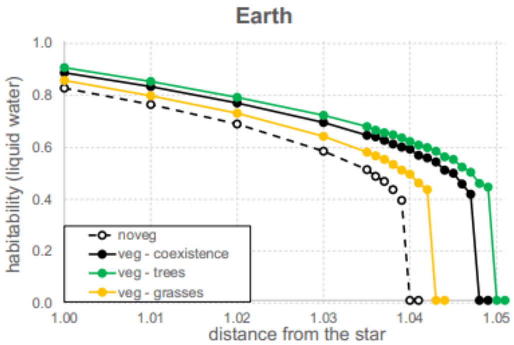
- Complete tree dominance (forest worlds).
- Complete grass dominance (grassland worlds).
- Tree/Grass coexistence.

- Bi-directional worlds

In a bi-directional world, vegetation converges to grassland or to forest, depending on the initial vegetation fractions. In these worlds, seed propagation across latitudes widens the region where forests and grasslands coexist.

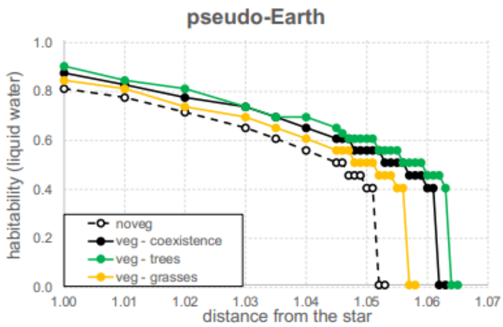
The researchers found that vegetation cover lowers a planet's albedo and warms the climate, nudging the outer limit of the habitable zone. However, they also arrived at more specific results.

They found that the outcome of dynamic competition between trees and grasses affected how vegetation is distributed across latitudes. "The achieved temperature-vegetation state is not imposed, but it emerges from the dynamics of the vegetation-climate system," they explain.



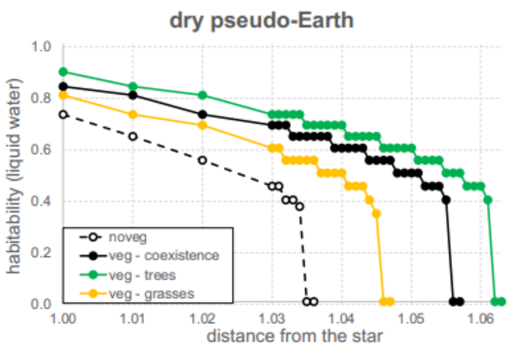
This figure from the research shows how Earth's liquid water habitability index is shifted outward by different vegetation regimes. It's based on Earth's modern distribution of continents. Image Credit: Bisesi et al. 2024.

The researchers worked with the idea of a 'pseudo-Earth.' The pseudo-Earth has a constant fraction of oceans at all bands of latitude, affecting the distribution of continents and vegetated surfaces relative to the equator, where most of the Sun's energy strikes the planet.



This figure from the research shows how a pseudo-Earth's liquid water habitability index is shifted outward by different vegetation regimes. It's based on an equal distribution of oceans at all bands of latitude. Image Credit: Bisesi et al. 2024.

The researchers also worked with a hypothetical dry pseudo-Earth. On this Earth, ocean cover is limited to 30%, while the Earth and the pseudo-Earth both have 70% ocean cover.



The simulated dry pseudo-Earth has less ocean coverage than Earth, meaning there's more surface area for vegetation to cover. Image Credit: Bisesi et al. 2024.

The team reached some conclusions about vegetation cover, albedo, and habitability.

The more continents a planet has, the greater the climate warming effect from vegetation. When the simulations resulted in a grass-dominated world, the effect was weaker because grass raises albedo. When the simulations resulted in a forest-dominated world, the effect was greater.

The researchers' key point is that none of this is static. Outcomes are driven by the competition between grasslands and forests for resources, which in turn is driven by the average temperature in each latitudinal band. "In general, thus, the achieved temperature-vegetation state is not imposed, but it emerges from the dynamics of the vegetation-climate system," they explain.

This is especially pronounced on the dry pseudo-Earth. Because there is so much land cover, vegetation has an even stronger effect on albedo and climate. "However, the ocean fraction cannot be too small, as
in this case, the whole hydrological cycle could be modified," the researchers add.

Overall, vegetation's effect on albedo and climate is small. But we can't dismiss its effect on habitability. Habitability is determined by a myriad of factors.

This issue is very complex. For instance, on a planet where grasslands and forests coexist, external factors like stellar luminosity and orbital variations can be buffered depending on where the continents are and how much their vegetation affects albedo purely by location.

The authors consider their work as a basic first step in this issue. They only included certain types of grasslands and forests, didn't include the relative availability of water, and didn't include atmospheric CO^2 concentrations.

"The dynamics explored here are extremely simplified and represent only a first step in the analysis of vegetation habitability interactions." they write. "Future work will also include a simplified carbon balance model in the study of planetary habitability."

"This endeavour should be seen as a first step of a research program aimed at including the main climate-vegetation feedbacks known for Earth in exoplanetary habitability assessments," they write.

Remember those Impossible Galaxies Found by JWST? It Turns Out They Were Possible After All

When the James Webb Space Telescope provided astronomers with a glimpse of the earliest galaxies in the Universe, there was some understandable confusion. Given that these galaxies existed during "Cosmic Dawn," less than one billion years after the Big Bang, they seemed "impossibly large" for their age. According to the most widely accepted cosmological model—the Lambda Cold Dark Matter (LCDM) model—the first galaxies in the Universe did not have enough time to become so massive and should have been more modestly sized.

This presented astronomers with another "crisis in cosmology," suggesting that the predominant model about the origins and evolution of the Universe was wrong. However, according to a new study by an international team of astronomers, these galaxies are not so "impossibly large" after all, and what we saw may have been the result of an optical illusion. In short, the presence of black holes in some of these early galaxies made them appear much brighter and larger than they actually were. This is good news for astronomers and cosmologists who like the LCDM the way it is!

The study was led by Katherine Chworowsky, a graduate student at the University of Texas at Austin (UT) and a National Science Foundation (NSF) Fellow. She was joined by colleagues from UT's Cosmic Frontier Center, NSF's NOIRLab, the Dunlap Institute for Astronomy & Astrophysics, the Mitchell Institute for Fundamental Physics and Astronomy, the Cosmic Dawn Center (DAWN), the Niels Bohr Institute, the Netherlands Institute for Space Research (SRON), NASA's Goddard Space Flight Center, the European Space Agency (ESA), the Space Telescope Science Institute (STScI), and other prestigious universities and institutes. The paper that details their findings recently appeared in *The Astrophysical Journal.*

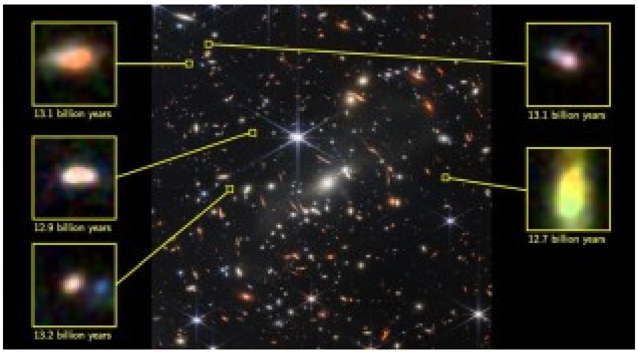
The first image taken by the James Webb Space Telescope, featuring the galaxy cluster SMACS 0723. Credit: NASA, ESA, CSA, and STScI

The data was acquired as part of the Cosmic Evolution Early Release Science (CEERS) Survey, led by Steven Finkelstein, a professor of astronomy at UT and a study co-author. In a previous study, Avishai Dekel and his colleagues at the Racah Institute of Physics at the Hebrew University of Jerusalem (HUJI) argued that the prevalence of low-density dust clouds in the early Universe allowed for rapid star formation in galaxies. Dekel and Zhaozhou Li (a Marie Sklodowska-Curie Fellow at HUJI) were also co-authors of this latest study.

As Chworowsky and her colleagues explained, the observed galaxies only appeared massive because their central black holes were rapidly consuming gas. This process causes friction, causing the gas to emit heat and light, creating the illusion of there being many more stars and throwing off official mass estimates. These galaxies appeared as "little red dots" in the *Webb* image (shown below). When removed from the analysis, the remaining galaxies were consistgent with what the standard LCDM model predicts.

"So, the bottom line is there is no crisis in terms of the standard model of cosmology," Finkelstein said in a UT News release. "Any time you have a theory that has stood the test of time for so long, you have to have overwhelming evidence to really throw it out. And that's simply not the case."

However, there is still the matter of the number of galaxies in the *Webb* data, which are twice as many as the standard model predicts. A possible explanation is that stars formed more rapidly in the early Universe. Essentially, stars are formed from clouds of dust and gas (nebulae) that cool and condense to the point where they undergo gravitational collapse, triggering nuclear fusion. As the star's interior heats up, it generates outward pressure that counteracts gravity, preventing further collapse. The balance of these opposing forces makes star formation relatively slow in our region of the cosmos.



The galaxy cluster SMACS0723, with the five galaxies selected for closer study. Credit: NASA, ESA, CSA, STScI / Giménez-Arteaga et al. (2023), Peter Laursen (Cosmic Dawn Center).

According to some theories, the Universe was much denser than it is today, which prevented stars from blowing out gas during formation, thus making the process more rapid. These findings echo what Dekel and his colleagues argued in their previous paper, though it would account for there being more galaxies rather than several massive ones. Similarly, the CEERS team and other research groups have obtained spectra from these black holes that indicate the presence of fast-moving hydrogen gas, which could mean that they have accretion disks.

The swirling of these disks could provide some of the luminosity previously mistaken for stars. In any case, further observations of these "little red dots" are pending, which should help resolve any remaining questions about how massive these galaxies are and whether or not star formation was more rapid during the early Universe. So, while this study has shown that the LCDM model of cosmology is safe for now, its findings raise new questions about the formation process of stars and galaxies in the early Universe.

"And so, there is still that sense of intrigue," said Chworowsky. "Not everything is fully understood. That's what makes doing this kind of science fun, because it'd be a terribly boring field if one paper figured everything out, or there were no more questions to answer."

Further Reading: UT News, *The Astronomical Journal*

Webb Discovers Six New "Rogue Worlds" that Provide Clues to Star Formation

Rogue Planets, or free-floating planetary-mass objects (FFPMOs), are planet-sized objects that either formed in interstellar space or were part of a planetary system before gravitational perturbations kicked them out. Since they were first observed in 2000, astronomers have detected hundreds of candidates that are untethered to any particular star and float through the interstellar medium (ISM) of our galaxy. In fact, some scientists estimate that there could be as many as 2 trillion rogue planets (or more!) wandering through the Milky Way alone.

In recent news, a team of astronomers working with the *James Webb Space Telescope* (JWST) announced the discovery of six rogue planet candidates in an unlikely spot. The planets, which include the lightest rogue planet ever identified (with a debris disk around it), were spotted during *Webb*'s deepest survey of the young nebula NGC 1333, a star-forming cluster about a thousand light-years away in the Perseus constellation. These planets could teach astronomers a great deal about the formation process of stars and planets.

The team was led by Adam Langeveld, an Assistant Research Scientist in the Department of Physics and Astronomy at Johns Hopkins University (JHU). He was joined by colleagues from the Carl Sagan Institute, the Instituto de Astrofísica e Ciências do Espaço, the Trottier Institute for Research on Exoplanets, the Mont Mégantic Observatory, the Herzberg Astronomy and Astrophysics Research Centre, the University of Texas at Austin, the University of Victoria, the Scottish Universities Physics Alliance (SUPA) at the University of St Andrews. The paper detailing the survey's findings has been accepted for publication in *The Astronomical Journal.*

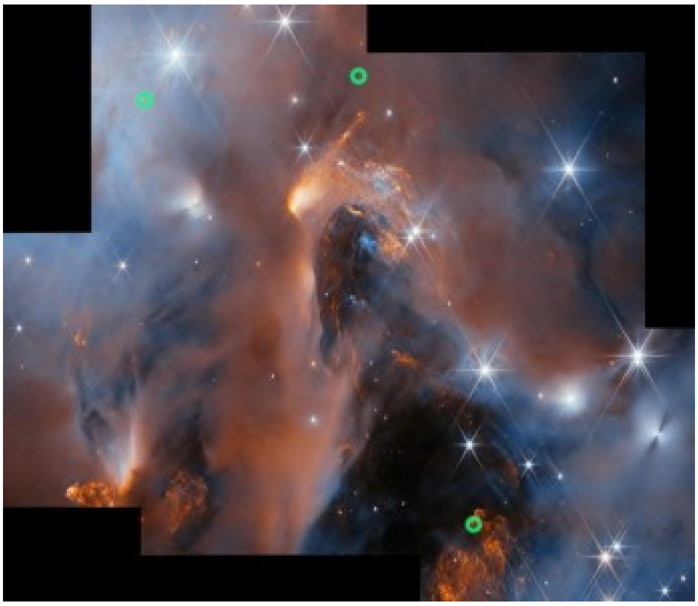
Most of the rogue planets detected to date were discovered using Gravitational Microlensing, while others were detected via Direct Imaging. The former method relies on "lensing events," where the gravitational force of massive objects alters the curvature of spacetime around them and amplifies light from more distant objects. The latter consists of spotting brown dwarfs (objects that straddle the line between planets and stars) and massive planets directly by detecting the infrared radiation produced within their atmospheres.

In their paper, the team describes how the discovery occurred during an extremely deep spectroscopic survey of NGC1333. Using data from *Webb*'s Near-Infrared Imager and Slitless Spectrograph (NIRISS), the team measured the spectrum of every object in the observed portion of the star cluster. This allowed them to reanalyze spectra from 19 previously observed brown dwarfs and led to the discovery of a new brown dwarf with a planetary-mass companion. This latter observation was a rare find that already challenges theories of how binary systems form. But the real kicker was the detection of six planets with 5-10 times the mass of Jupiter (aka. super-Jupiters).

This means these six candidates are among the lowest-mass rogue planets ever found that formed through the same process as brown dwarfs and stars. This was the purpose of the Deep Spectroscopic Survey for Young Brown Dwarfs and Free-Floating Planets survey, which was to investigate massive objects that are not quite large enough to become stars. The fact that *Webb*'s observations revealed no objects lower than five Jupiter masses (which it is sensitive enough to detect) is a strong indication that stellar objects lighter than are more likely to form the way planets do.

Said lead author Langeveld in a statement released by JHU's new source (the Hub):

"We are probing the very limits of the star-forming process. If you have an object that looks like a young Jupiter, is it possible that it could have become a star under the right conditions? This is important context for understanding both star and planet formation."



New wide-field view mosaic from the James Webb Space Telescope spectroscopic survey of NGC1333 with three of the newly discovered free-floating planetary-mass objects indicated by green markers. Credit: ESA/Webb, NASA & CSA, A. Scholz, K. Muzic, A. Langeveld, R. Jayawardhana

The most intriguing of the rogue planets was also the lightest: an estimated five Jupiter masses (about 1,600 Earths). Since dust and gas generally fall into a disk during the early stages of star formation, the presence of this debris ring around the one planet strongly suggests that it formed in the same way stars do. However, planetary systems also form from debris disks (aka. circumsolar disks), which suggests that these objects may be able to form their own satellites. This suggests that these massive planets could be a nursery for a miniature planet system – like our Solar System, but on a much smaller scale.

Said Johns Hopkins Provost Ray Jayawardhana, an astrophysicist and senior author of the study (who also leads the survey group):

"It turns out the smallest free-floating objects that form like stars overlap in mass with giant exoplanets circling nearby stars. It's likely that such a pair formed the way binary star systems do, from a cloud fragmenting as it contracted. The diversity of systems that nature has produced is remarkable and pushes us to refine our models of star and planet formation…

"Our observations confirm that nature produces planetary mass objects in at least two different ways—from the contraction of a cloud of gas and dust, the way stars form, and in disks of gas and dust around young stars, as Jupiter in our own solar system did."

In the coming months, the team plans to use Webb to conduct follow-up studies of these rogue planets' atmospheres and compare them to those of brown dwarfs and gas giants. They also plan to search the star-forming region for other objects with debris disks to investigate the possibility of mini-planetary systems. The data they obtain will also help astronomers refine their estimates on the number of rogue planets in our galaxy. The new Webb observations indicate that such bodies account for about 10% of celestial bodies in the targeted cluster.

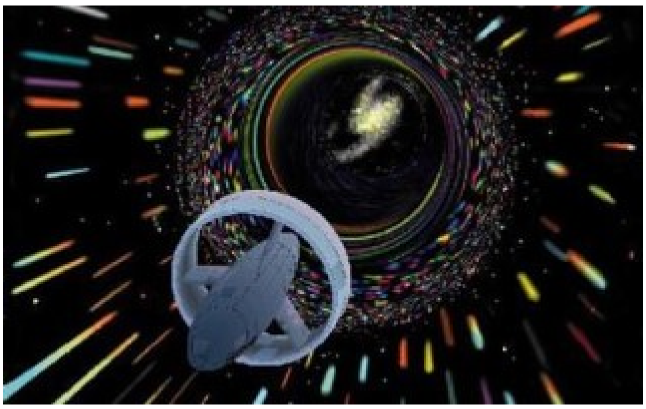
Current estimates place the number of stars in our galaxy between 100 and 400 billion stars and the number of planets between 800 billion and 3.2 trillion. At 10%, that would suggest that there are anywhere from 90 to 360 billion rogue worlds floating out there. As we have explored in previous articles, we might be able to explore some of them someday, and our Sun may even capture a few!

Further Reading: HUB

What if you Flew Your Warp Drive Spaceship into a Black Hole?

Warp drives have a long history of not existing, despite their ubiquitous presence in science fiction. Writer John Campbell first introduced the idea in a science fiction novel called Islands of Space. These days, thanks to Star Trek in particular, the term is very familiar. It's almost a generic reference for superliminal travel through hyperspace. Whether or not warp drive will ever exist is a physics problem that researchers are still trying to solve, but for now, it's theoretical.

Recently, two researchers looked at what would happen if a ship with warp drive tried to get into a black hole. The result is an interesting thought experiment. It might not lead to starship-sized warp drives but might allow scientists to create smaller versions someday.



NASA's Eagleworks attempted to test Alcubierre warp drive concept. Credit: 2012

Remo Garattini and Kirill Zatrimaylov theorized that such a drive could survive inside a so-called Schwarzschild black hole. That's provided the ship crosses the event horizon at a speed lower than that of light. Theoretically, the black hole's gravitational field would decrease the amount of negative energy required to keep the drive going. If it did, the ship could pass through and somehow use it to get somewhere else without getting crushed. Furthermore, the mathematics behind this idea points the way toward the possible creation of mini-warp drives in lab settings.

What's a Warp Drive?

Could scientists build a micro- or mini-warp drive in the lab? Good questions. To understand the team's work, let's look at the major players in this research: warp drives and black holes.

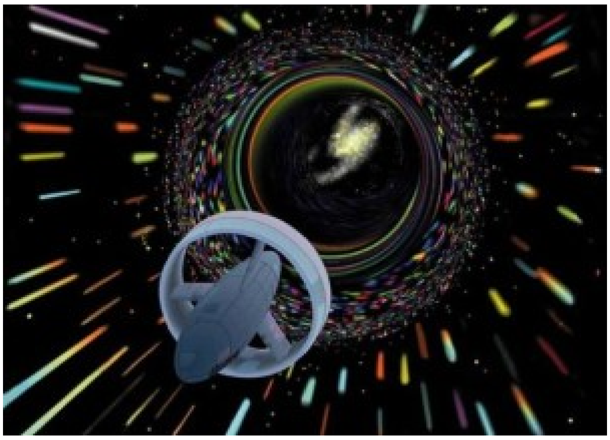
The idea is inspired by the fact that nothing can go faster than light speed. Given the distances in space, traveling to the nearest star would take years (if we could go at light speed). Going across a galaxy or to more distant galaxies would take years and many lifetimes. So, if you want to be a space-faring species, you must travel faster than light (FTL).

How would you do that? This is where warp drives come in. Theoretically, they allow you to put your spaceship inside a bubble that could slip through space at FTL speeds. That's how the starships in Star Trek (and other SF stories) get across huge distances so quickly. The Star Trek ships use an energy source in a "warp core" to power warp field generators. They create the warp bubble in subspace. The ship uses that to go wherever the crew needs to be.

Do Physicists Like Warp Drive?

Such a warp drive is a tantalizing idea with many caveats. For example, generating a warp field requires an insane amount of energy. Some physicists suggest that it would take more energy than we're capable of generating. Creating that energy would require huge amounts of exotic matter—something like "unobtanium". So, that's a problem right there.

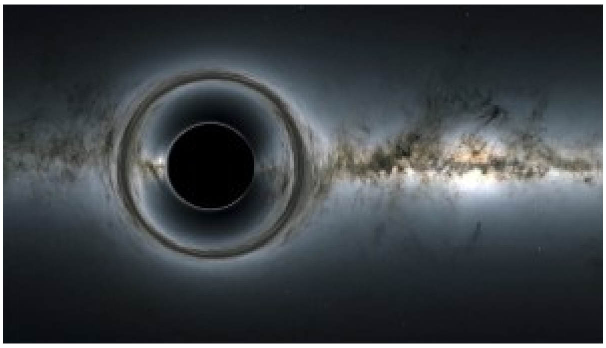
Others say that creating such a drive goes against our current understanding of spacetime physics. However, that hasn't stopped anybody from speculating on ways to make it happen. For example, Mexican physicist Miguel Alcubierre had an idea for such a drive in 1994. He suggested that it could create a bubble that would shift space around an object. He has continued his research about a ship that could get somewhere faster than light. However, he and others still point out various problems with both creating and sustaining a warp drive. That includes the idea that such a drive effectively isolates itself from the rest of the Universe. Among other things, it means the ship can't control the drive that's making it go. So, there are a still few bugs to work out.



This artist's illustration shows a spacecraft using an Alcubierre Warp Drive to warp space and 'travel' faster than light. Image Credit: NASA

About Black Holes

We are most familiar with black holes in terms of stellar mass and supermassive ones. These also sport accretion disks that convey material into the black hole. For example, the central supermassive black hole named Sagittarius A* in our own Milky Way Galaxy periodically gobbles down material. Then, it emits a belch of radiation. Other, more active galaxies send out jets of material emitted as the central supermassive black hole feeds continuously.



Simulation of a black hole. (Credit: NASA/ESA/Gaia/DPAC)

A black hole is a concentration of mass with gravity so strong that nothing, even light, can escape. In their study about black holes and warp drives, the authors used Schwarzschild black holes. These so-called simple "static" black holes curve spacetime, have no electric charge and are non-rotating. Essentially, they are good approximations for mathematical explorations of the characteristics of slowly rotating objects in space.

When A Ship with Warp Drive Crosses into a Black Hole

The Schwarzchild black hole is the "perfect" black hole to use in this theoretical exploration of a warp drive crossing the event horizon. To figure out the scenario, Garattini and Zatrimalov decided to mathematically combine the equations describing the black hole and the ones describing the warp drive. Among other things, they found that it's possible to "embed" the warp drive in the outer region of the black hole. The warp bubble itself is much smaller than the black hole and needs to be moving toward it. The black hole's gravity affects the energy conditions needed to create and sustain the warp drive. That means you can theoretically decrease the amount of negative energy required to sustain the warp bubble. In addition, the researchers suggest that if the warp bubble is moving at less than the speed of light, it effectively erases the black hole horizon.

The research team also described the idea that such an occurrence could evoke the conversion of virtual particles into real ones in an electric field. If so, it could lead to the creation of mini warp drives in the lab.

Changing the Black Hole a Bit

Interestingly, the team also suggests that, if the warp bubble is moving slowly and is much smaller than the black hole horizon, it could increase the entropy of the black hole. However, as they state in their closing arguments, "there are potential problematic issues in other physical situations: namely, when the warp drive is completely absorbed by the black hole, it may decrease its mass, and, therefore, its entropy.

Likewise, when there is a larger warp bubble passing through a black hole, it would produce a "screening" effect and de facto eliminate the horizon, making it impossible to define the black hole entropy in the Hawking sense. If warp drives are possible in nature, these issues indicate that we still do not understand them from the thermodynamic point of view."

Warp Drive Technology Remains to be Seen

So, while this research may prove valuable theoretically, and could lead to lab production of mini black holes, many questions remain. Perhaps in the future, when we understand the quantum mechanics behind both of these objects, we might find warp technology a slam-dunk. If so, then, as ships travel through black holes, we could face a weird time. For example, signals from inside a black hole could get carried out by a warp bubble merging from the singularity. That would allow us to send images or recordings of what it's like inside the event horizon—something nobody knows about today. There's also a chance that those fearsome black holes could make a warp drive less difficult to achieve since they won't need so much exotic "negative energy" source material.

For More Information

Black Holes, Warp Drives, and Energy Conditions
The Warp Drive: Hyper-fast Travel Within General Relativity
Schwarzschild Black Hole Simulations

Is Betelgeuse Actually a Binary Star?

Betel-gurz or Beetle-juice has been a favourite among amateur astronomers for many years. However you pronounce it, its unexpected dimming draw even more attention to this red supergiant variable star in Orion. It has a few cycles of variability, one of them occurs over a 2,170 day period, 5 times longer than its normal pulsation period. A paper has just been published that suggests a companion star of 1.17 solar masses could be the cause. It would need an orbit about 2.43 times the radius of Betelgeuse and it might just lead to the modulation of dust in the region that causes the variations we see.

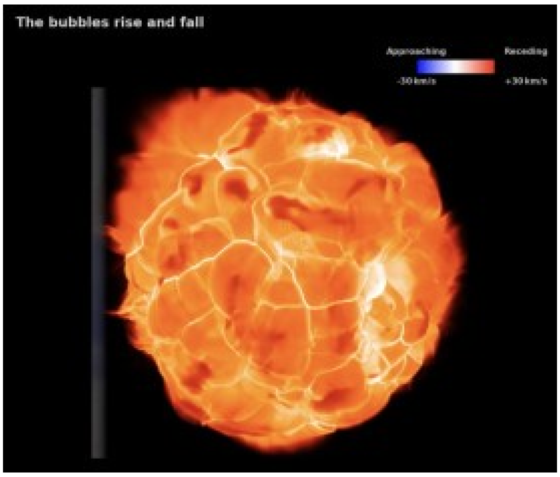
One of the brightest stars in the sky, Betelgeuse is a red supergiant found situated prominently at the upper left of the constellation Orion. It represents the shoulder of the hunter although some translations suggest it refers to 'the armpit of the giant!' It's one of the largest stars visible to the unaided eye with a radius about 1,000 times the Sun. At a distance of 642 light years away, its brightness in our sky tells us it must be giving out about 100,000 times more light than the Sun. Over the last five years it's been getting special attention due to its unexpected dimming.

Ground-based image of the Constellation of Orion. The Hubble Space Telescope continues to reveal various stunning and intricate treasures that reside within the nearby, intense star-forming region known as the Great Nebula in Orion.

The dimming occurred toward the end of 2019 and the returned to normal in the first half of 2020. It's generally accepted that the dimming was caused by a dust cloud in the event that has now been dubbed 'The Great Dimming.' The observations of the dimming led to a change in our understanding of the behaviour of Betelgeuse and its surrounding environment such as the apparent 5km/s surface rotation, models of the nature of its variability and pulsation models (the periodic expansion and contraction of the star's outer layers.)

As a well known variable star, the light curve of Betelgeuse displays a Long Secondary Period (LSP) of approximately 2100 days. It's not unusual for stars in the Red Giant Branch of the Hertzsprung-Russell Diagram and can range from a few hundred days to thousands. To date though, the mechanism behind the LSP is unknown but it certainly does seem to be a secondary cycle to a shorter one. Interestingly the duration of the LSP seems to be generally in the region of a few tens of times slower than the stars radial pulsation.

It's the nature of this longer term variability in Betelgeuse that is the focus of a new paper published by Jared A. Goldberg and his team. A greater understanding will lead to a greater clarity of Betelgeuse's evolutionary stage and ultimately to its death. One solution points to it simply being the result of the pulsation of the outer layers. If this were the case then it means Betelgeuse is larger than expected and would be further along its evolution branch and that a supernova explosion may be imminent within the next few hundred years! An exciting prospect for the stargazers among us.



Simulation of Betelgeuse's boiling surface

Interestingly though, the team conclude that the most likely explanation for the long term variability of Betelgeuse is a low mass companion star, named ? Ori B (Betelgeuse bares the alternative name ? Orionis.) It is possible that this binary star could be modulating the dust surrounding the system and when the companion is in transit, the dust leads to a reduction in brightness. If ? Ori B were to be confirmed, it would have a significant impact on our evolutionary understanding of Betelgeuse. It is expected to go supernova soon but this is largely because observed variations led to the conclusion it was close. Instead, ? Ori B being the cause means we may have some time to wait after all.

NASA Announces the 2025 Human Lander Challenge

One of NASA's core mission objectives, though not explicitly stated in its charter, is to educate Americans about space exploration, especially students. As part of that mission, NASA hosts a number of challenges every year where teams of students compete to come up with innovative ideas to solve problems. The agency recently announced the next round of one of its standard yearly challenges—the Human Lander Challenge.

The Human Lander Challenge occurs every year, and objectives vary based on the specific problem related to human landers NASA is trying to solve. This year, the focal problem is cryogenic fluid storage.

Currently, no technology exists to store cryogenic fluid in space for long periods, but any lander mission would need to store cryogenic fuel for months. Typically, cryogenics would boil away in that time frame, but large amounts will be required to fuel landers or orbiting stations. Particular problems could focus on low-leakage components, large-scale insulation, or propellant transfer technologies.

Recruitment vide for the Human Lander Challenge.
Credit – Human Lander Challenge YouTube Channel

To address that problem, NASA is turning to teams of undergraduate or graduate students at some of the top universities in the world. Since this competition repeats annually, some universities have a pedigree of competing in and winning the challenge. This year, the top three teams were from the University of Michigan, the University of Illinois-Urbana Champaign, and the University of Colorado-Boulder, all of which would potential field teams to compete this year.

Interested teams will compete in two rounds. The first round of judging will take place in March 2025, and twelve teams will be notified of their invitation to the final round in April. That final round will take place at a forum held in Huntsville, Alabama, in late June next year.

Between now and then, though, teams will able to submit a notice of intent, get their questions answered by NASA experts, and have to submit a proposal. The finalists will receive a cash award to continue their work, involving a full technical paper and slide deck to be presented at the forum.

Fraser discusses the options for the eventual Artemis lander.

Details about the challenge are posted on its website. It's being run through the agency's Human Landing System Program directorate and managed by the National Institute of Aerospace. If you're looking for inspiration, the challenge team has also posted a motivational video about the opportunities the challenge presents.

Any technology planned for a detailed assessment would need to be about 3-5 years from maturity, which would align well with the Artemis mission's timelines. However, it remains to be seen if any solutions will be adopted into the mission architecture. If they are, some students will say they've participated in the most challenging human space endeavor in almost 60 years—that's a pretty good resume builder, if nothing else.

Learn More:
NASA – 2025 Human Lander Challenge
NASA – NASA Announces Winners of Inaugural Human Lander Challenge
UT – NASA Wants Heavy Cargo Landers for the Moon
UT – NASA is Pushing Back its Moon Landings to 2026

NASA Decides to Play it Safe. Wilmore and Williams are Coming Home on a Crew Dragon in February

Astronauts Butch Wilmore and Suni Williams will remain on board the International Space Station until February, returning to Earth on a SpaceX Crew Dragon. NASA announced its decision over the weekend, citing concerns about the safety of the Boeing Starliner capsule due to helium leaks and thruster issues. The troublesome Starliner is slated to undock from the ISS without a crew in early September and attempt to return on autopilot, landing in the New Mexico desert.

NASA said this allows them and Boeing to continue gathering test data on Starliner during its uncrewed flight home, while also not accepting more risk than necessary for the crew.

"Decisions like this are never easy, but I want to commend our NASA and Boeing teams for their thorough analysis, transparent discussions, and focus on safety during the Crew Flight Test," Ken Bowersox, associate administrator for NASA's Space Operations Mission Directorate said in a NASA press release. "We've learned a lot about the spacecraft during its journey to the station and its docked operations. We also will continue to gather more data about Starliner during the uncrewed return and improve the system for future flights to the space station."

Boeing's CTS-100 Starliner taking off from Cape Canaveral, Florida, on June 5th, 2024. Credit: NASA

Wilmore, 61, and Williams, 58, flew to the ISS in June on Starliner for the long-awaited Boeing Crew Flight Test. The two astronauts are not strangers to long-duration missions, as they have both served on ISS expeditions and they will now officially join the Expedition 71/72 crew on board the space station. Their ride home is scheduled to launch in late September with two astronauts instead of the usual four to make room for Wilmore and Williams to return home with the two Crew-9 members in February 2025.

"This has not been an easy decision, but it is absolutely the right one," Jim Free, NASA's associate administrator said at the briefing on Saturday.

The decision is especially disappointing for Boeing, as the company has been plagued with problems with its airplanes and was counting on Starliner's first crewed trip to revive the troubled spacecraft program, which has suffered years of delays due to issues with Starliner. The company had asserted Starliner was safe based on all the recent thruster tests both in space and on the ground.

Boeing's Starliner crew capsule docked to the Harmony module's forward port at the International Space Station on July 6, 2024. Photo credit: NASA

While Boeing did not participate in Saturday's news conference, they released a statement saying, "Boeing continues to focus, first and foremost, on the safety of the crew and spacecraft." The company said it is preparing the spacecraft for a safe and successful return.

NASA and Boeing identified the helium leaks during the flight to the ISS, and the thruster issues after the spacecraft experienced issues with its reaction control thrusters as Starliner approached the space station on June 6.

"Since then, engineering teams have completed a significant amount of work, including reviewing a collection of data, conducting flight and ground testing, hosting independent reviews with agency propulsion experts, and developing various return contingency plans," NASA said in their press release. "The uncertainty and lack of expert concurrence does not meet the agency's safety and performance requirements for human spaceflight, thus prompting NASA leadership to move the astronauts to the Crew-9 mission."

The seven Expedition 71 crew members gather with the two Crew Flight Test members for a team portrait aboard the space station. In the front from left are, Suni Williams, Oleg Kononenko, and Butch Wilmore. Second row from left are, Alexander Grebenkin, Tracy C. Dyson, and Mike Barratt. In the back are, Nikolai Chub, Jeanette Epps, and Matthew Dominick. Photo credit: NASA

The fact that Starliner will return home without a crew is not an issue, as is designed to operate autonomously and previously completed two uncrewed flights. This mission is the second time the Starliner has flown to the ISS and the third flight test overall. During the first uncrewed test flight (OFT-1), which took place back in December 2019, the Starliner launched successfully but failed to make it to the ISS because of software issues. After making 61 corrective actions recommended by NASA, another attempt was made (OFT-2) on May 22nd, 2022. That flight successfully docked to the ISS, staying there for four days before undocking and landing in the White Sands Missile Range in New Mexico.

This first crewed flight of Starliner was supposed to validate the spacecraft as part of NASA's Commercial Crew Program (CCP), with the hope of it working alongside SpaceX's Crew Dragon to make regular deliveries of cargo and crew to the ISS. The launched was delayed when parachute and other issues cropped up, including a helium leak in the capsule's propellant system that scrubbed a launch attempt in May. The leak eventually was deemed to be isolated and small enough to pose no concern. But more leaks occurred following liftoff, and five thrusters also failed.

NASA and Boeing will work together to adjust end-of-mission planning and Starliner's systems to set up for the uncrewed return in the coming weeks. Starliner must return to Earth before the Crew-9 mission launches to ensure a docking port is available on station.

"Starliner is a very capable spacecraft and, ultimately, this comes down to needing a higher level of certainty to perform a crewed return," said Steve Stich, manager of NASA's Commercial Crew Program. "The NASA and Boeing teams have completed a tremendous amount of testing and analysis, and this flight test is providing critical information on Starliner's performance in space. Our efforts will help prepare for the uncrewed return and will greatly benefit future corrective actions for the spacecraft."

Is Science Slowing Down?

Paradoxically, even though we produce more scientific output than ever before – each year, researchers around the world publish millions of academic papers – the pace of scientific discovery is slowing down.

There are several factors behind this general slow-down of scientific advancement, but the most important factor is the simple maturation of any field.

As time goes on fields of science become more mature and sophisticated. This is a good thing, as we take small threads of newfound knowledge and develop them into full-fledged theories of the workings of the universe. But this process ironically slows the pace of future discoveries in that same field.

This is because our questions are becoming more sophisticated, more targeted. In any field of science, the pace of discovery is quite rapid, as individual researchers are capable of making amazing breakthroughs with just their minds or a few simple laboratory experiments and observations. But once those easy questions are answered, all that are left are the hard ones; the problems that require collaborations of humans working together and pooling their resources, the ones that require massive investments in time or money, the ones that require intense effort, years of investigation, to chip away at some small corner of the overall problem.

For example, consider cosmology. A century ago, barely anybody was concerned with the nature and fate of the universe. Even after Hubble's discovery of an expanding universe, cosmology was considered a niche subject. But its small set of practitioners were able to make astounding leaps, cementing the Big Bang's place as the key theory of the history of the universe. Today, advancement in science is slowing, with teams of hundreds spending millions of dollars to develop a single survey.

Cosmology is not alone.

Imagine fields of science like a growing soap bubble. The volume of the bubble is knowledge we have already acquired, and the edge of the bubble represents the frontiers of that knowledge. At first the bubble is small, with both a small volume and small surface. When we learn new knowledge about the surface, we expand that surface area, and the volume correspondingly grows.

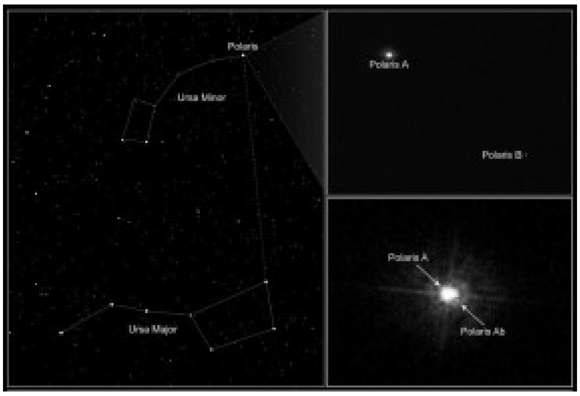
When the bubble is small, it doesn't take much to radically increase its volume – even the work of one human is enough to double or triple our total human knowledge of a subject. But as the bubble expands, the volume becomes much bigger than its surface. New knowledge, pushing at the boundaries, only supplies proportionally less new information. Progress becomes harder and harder, and advancement slows down – sometimes grinding to a halt.

This isn't necessarily a bad thing. Fields of science emerge, grow rapidly, and mature. We can still learn new things in any field, but this general tendency means that we shouldn't expect rapid leaps and bounds. We just have to manage our expectations.

Polaris, Earth's North Star, Has A Surprisingly Spotted Surface

Humanity's been fortunate to have a star situated over Earth's north pole. The star, known as Polaris, or the North Star, has guided many sailors safely to port. But Polaris is a fascinating star in its own right, not just because of its serendipitous position.

Polaris is also called the Pole Star, and it's actually a triple star system. The primary star is a yellow supergiant named Polaris Aa, about 448 light-years away, and it orbits with a smaller companion named Polaris Ab. The outer star is named Polaris B and may also have a dim companion. In this article, Polaris refers to the primary star, Polaris Aa.



These Hubble images show the locations of the Polaris stars. Polaris Aa is labelled Polaris A in this image, and Polaris AB is labelled Polaris B. Image Credit: By NASA/ HST – (Image: STScI-2006-02), Public Domain.

Polaris hasn't always been the North Star, and it won't always be. Thuban was the North Star from the 4th to 2nd millennium BC until Earth's axial precession gave that position to Polaris. The Pole Star changes during a 26,000-year cycle, so Thuban will take over from Polaris in the year 20346.

But whether Polaris is the Pole Star at a particular time or not, it's an interesting object whose properties can help us understand the expansion of the Universe.

Polaris is a variable star that pulses and changes brightness over time. Specifically, it's a Cepheid variable. Cepheid variables expand and contract rhythmically, and their brightness changes in a predictable pattern. Because there's a direct relationship between their pulsation period and their luminosity, they're useful in measuring distances. They're called "standard candles" and are part of the cosmic distance ladder.

Astronomers use standard candles to help measure the Hubble constant, or how rapidly the Universe is expanding. But there's some tension between our measurements of the Hubble constant. When we use local objects like Cepheid variables to measure the Hubble constant, we get a different number than when we use larger-scale things like the Cosmic Microwave Background to measure it.

Since Polaris is such a nearby standard candle, a team of astronomers used a telescope array to watch the star for 30 years. By more accurately observing Polaris and its smaller companion Polaris Ab, they hoped to constrain Polaris' mass and other characteristics more accurately. This, in turn, could help us understand the tension in the Hubble constant. Along the way, the researchers uncovered some surprises surrounding this long-observed star.

Their results are in a paper titled "The Orbit and Dynamical Mass of Polaris: Observations with the CHARA Array." It's published in The Astrophysical Journal, and the lead author is Nancy Evans. Evans is an astrophysicist at the Center for Astrophysics | Harvard & Smithsonian.

In order to understand Polaris better, it's critical to get a good look at its dim companion. But that's not easy to do.

"The small separation and large contrast in brightness between the two stars makes it extremely challenging to resolve the binary system during their closest approach," Evans said.

The CHARA (Center for High Angular Resolution Astronomy) Array was built to bring clarity to objects like Polaris and its dim companion. It's an interferometer, an array of six separate telescopes, each with a one-meter-diameter primary mirror. By combining the images from each separate scope, CHARA attains the higher resolution of a telescope with a primary mirror that's 330 meters in diameter, the area covered by the individual 'scopes. CHARA has a special camera designed to work with it called MIRC-X (Michigan InfraRed Combiner-eXeter).

With these tools, the astronomers tracked Polaris and its dim companion over a 30-year period. They measured how the Cepheid variable changed size as it pulsated. They learned that it's five times as massive as the Sun and has a diameter 46 times larger than the Sun. However, the mass measurement is affected by the star's large orbital eccentricity, 0.63, so there's still some uncertainty about Polaris' mass.

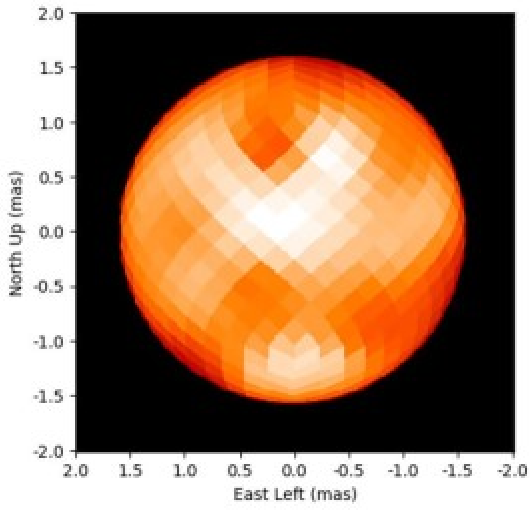
The measured mass and luminosity also show that Polaris is more luminous than it should be for a star on its evolutionary track. "Polaris is at least 0.4 mag brighter than the predicted tracks," the authors write in their paper. This is important because of the "Cepheid mass problem." It's a discrepancy between masses inferred from stellar evolutionary tracks and masses from pulsation calculations.

A Cepheid variable's mass can be determined when it's in a binary relationship. "Mass determination starts with a radial velocity (RV) orbit and pulsation curve for a binary containing a Cepheid," the authors explain. Very few Cepheid variables are in binary relationships like Polaris, so it's an important target for constraining and understanding their masses. These measurements are all important because they relate back to the cosmic distance ladder, standard candles, and the Hubble constant.

"The accuracy of inputs from any of these measurements depends on many characteristics of the star: brightness, orbital period, inclination, and the separation, distance, and mass ratio of the components. This means that each Cepheid system is unique and has to be analyzed independently," the authors explain.

The observations also showed variable spots on the star's surface.

"The CHARA images revealed large bright and dark spots on the surface of Polaris that changed over time," said Gail Schaefer, director of the CHARA Array.



This CHARA Array false-colour image of Polaris from April 2021 reveals large bright and dark spots on the surface. Image Credit: Evans et al. 2024.

"The identification of starspots is consistent with several properties of Polaris," the researchers write. It's different from other Cepheid variables because it has a very low pulsation amplitude. That could mean that its atmosphere is more like a nonvariable supergiant. Those atmospheres often seem to be active, much like the spots on Polaris. "It is not clear how full amplitude pulsation affects the atmosphere and magnetic field in pulsators, so Polaris is an interesting test case," they explain.

The spots are variable, which could explain why astronomers have struggled to identify other "additional periodicities" in the star. They could also explain an observed ~120-day radial velocity variation as a rotation period.

The spots on Polaris' surface have added to the star's complexity, and they're begging to be understood.

"We plan to continue imaging Polaris in the future," said study co-author John Monnier, an astronomy professor at the University of Michigan. "We hope to better understand the mechanism that generates the spots on the surface of Polaris."

The Wow! Signal Deciphered. It Was Hydrogen All Along.

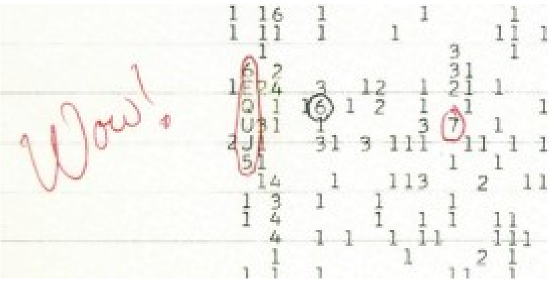
In 1977, astronomers received a powerful, peculiar radio signal from the direction of the constellation Sagittarius. Its frequency was the same as neutral hydrogen, and astronomers had speculated that any ETIs attempting to communicate would naturally use this frequency. Now the signal, named the Wow! Signal has become lore in the SETI world.

But what was it?

Beginning in the 1970s, the Ohio State University Big Ear radio telescope was used in the university's Search for Extraterrestrial Intelligence (SETI) program, which ran from 1973 to 1995. This program is the longest-running SETI program in history.

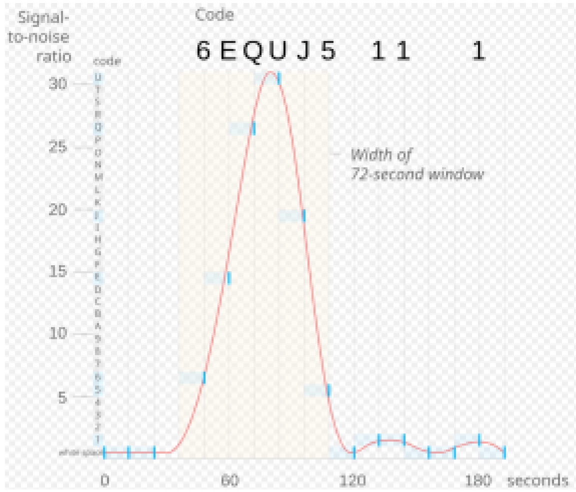
In 1977, Big Ear detected a peculiar signal that's taken on a life of its own: the Wow! Signal. The Wow! Signal was a strong narrowband radio signal right near the frequency of neutral hydrogen. The Big Ear telescope is long gone now, but the effort to understand what the signal is lives on.

The signal lasted the full 72-second window in which Big Ear was able to observe it. A few days later, astronomer Jerry R. Ehman was looking over the data when he saw the signal on a computer printout. Astronomers had never seen anything like it, and he wrote "Wow!" beside it, and the name has stuck ever since.



The Wow! signal from 1977 as discovered by astronomer Jerry R. Ehman. Image via Big Ear Radio Observatory and North American AstroPhysical Observatory (NAAPO).

The signal has another name: 6EQUJ5. This has been interpreted as a message hidden in the signal, but it really represents how the signal's intensity varied over time.



This image is a plot of the Wow! signal's intensity versus time. Image Credit: By Maxrossomachin – Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16197844

The signal generated a lot of excitement. Some thought it was extraterrestrial in origin, some thought it could come from some type of human-generated interference, and some thought it could be from an unexplained natural phenomenon.

New research shows that the Wow! Signal has an entirely natural explanation.

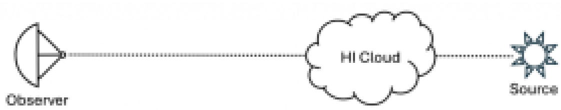
The research is "Arecibo Wow! I: An Astrophysical Explanation for the Wow! Signal." The lead author is Abel Méndez from the Planetary Habitability Laboratory at the University of Puerto Rico at Arecibo. It's available at the pre-print server arxiv.org.

Arecibo Wow! is a new effort based on an archival study of data from the now-defunct Arecibo Radio Telescope from 2017 to 2020. The observations from Arecibo are similar to those from Big Ear but "are more sensitive, have better temporal resolution, and include polarization measurements," according to the authors.

"Our latest observations, made between February and May 2020, have revealed similar narrowband signals near the hydrogen line, though less intense than the original Wow! Signal," said Méndez.

Arecibo detected signals similar to the Wow! signal but with some differences. They're far less intense and come from multiple locations. The authors say these signals are easily explained by an astrophysical phenomenon and that the original Wow! signal is, too.

"We hypothesize that the Wow! Signal was caused by sudden brightening from stimulated emission of the hydrogen line due to a strong transient radiation source, such as a magnetar flare or a soft gamma repeater (SGR)," the researchers write. Those events are rare and rely on precise conditions and alignments. They can cause clouds of hydrogen to brighten considerably for seconds or even minutes.



This simple schematic shows how the Wow! Signal was generated and detected. A radiative source such as a magnetar or a soft gamma repeater is positioned behind a cloud of cold neutral hydrogen. Energy from the source stimulates emission from the HI cloud, which brightens abruptly and is observable from Earth. Image Credit: Méndez et al. 2024.

The researchers say that what Big Ear saw in 1977 was the transient brightening of one of several H1 (neutral hydrogen) clouds in the telescope's line of sight. The 1977 signal was similar to what Arecibo saw in many respects. "The only difference between the signals observed in Arecibo and the Wow! Signal is their brightness. It is precisely the similarity between these spectra that suggests a mechanism for the origin of the mysterious signal," the authors write.

These signals are rare because the spatial alignment between source, cloud, and observer is rare. The rarity of alignment explains why detections are so rare.

The researchers were able to identify the clouds responsible for the signal but not the source. Their results suggest that the source is much more distant than the clouds that produce the hydrogen signal. "Given the detectability of the clouds as demonstrated in our data, this insight could enable precise location of the signal's origin and permit continuous monitoring for subsequent events," the researchers explain.

The Wow! Signal was originally interpreted as a technosignature by many. By explaining where the signal came from, this research outlines a new source of false positives.

"Our hypothesis explains all observed properties of the Wow! Signal, proposes a new source of false positives in technosignature searches, and suggests that the Wow! Signal could be the first recorded event of an astronomical maser flare in the hydrogen line," the authors explain in their conclusion.

Webb Relieves the Hubble Tension

Sometimes, when scientists measure things differently, they get different results. Whenever that happens with something as crucial to humanity's long-term future as the universe's expansion rate, it can draw much attention. Scientists have thought for decades that there has been such a difference, known as the Hubble Tension, in measurements of the speed at which the universe is expanding. However, a new paper by researchers at the University of Chicago and the Carnegie Institution for Science using data from the James Webb Space Telescope (JWST) suggests that there wasn't any difference at all.

To understand this more, let's first look at the Hubble tension. Edwin Hubble, the namesake of the Hubble Space Telescope, JWST's predecessor, first found the universe was expanding when he looked at the speed at which galaxies travel. He found galaxies that were farther away from us were traveling faster than those nearest to us, and the best answer that we have as to why is that the universe itself is expanding.

It does not do so on a scale that we would notice in our daily lives, but on the scale of the space between galaxies, it is definitely noticeable, and in a number of ways. Historically, there have been two different ways to measure this Hubble Constant, as the rate of expansion is known. One involved studying the Cosmic Microwave Background (CMB), and one involved looking at the speed of galaxies, as Hubble did.

Data on the CMB have been consistent and precise for a long time. Studies have shown that it points to an expansion rate of 67.5 kilometers per second per megaparsec. To put that into perspective, the universe adds a little under an hour of highway drive time every second but does so on the scale of 3.2 million light years. Again, that expansion is not noticeable on our own scale, but on the immense scales of the universe, it is very noticeable.

However, calculations of that expansion value differ for the second method of measuring galaxies. Traditionally, the value is higher by about 9% and is estimated at 74 kilometers per second per megaparsec. That measurement is typically done using data from two different kinds of stars in those far and near galaxies – Cepheid variables and "Tip of the Red Giant Branch."

Dr. Wendy Freedman, one of the paper's authors, is an expert in using Cepheid variables to measure the distance of things, so getting a chance to use JWST's even more precise instrumentation was likely an excellent moment for her and her team. But they didn't stop there. They added data from another type of star, whose use in calculating distance to an object has recently become more popular. Carbon stars are known for their consistent brightness and wavelengths in near-infrared – exactly the wavelengths JWST was designed to study. Using those known properties, the researchers could calculate redshift and other variables, allowing them to use this new technique to validate their version of the Hubble Constant.

Measuring distance is hard in astronomical terms, as Fraser discusses in this video.

The number they found was much closer to that calculated by the CMB method – 70 kilometers per second per megaparsec, a difference of only 3.5%. That's within the bounds of estimations for most astronomical calculations, so the authors suggest there might not be a Tension between the two measurements.

That claim will undoubtedly spark some controversy in the astronomical community, as there are some theories with plenty of proponents to explain the difference in measurements. But, as instruments like JWST provide more and more detailed data and researchers are better able to constrain some of the astronomically large values, one day, we might prove that this existential crisis that has been sitting at the center of cosmology for decades might never have been a thing at all.

Are Andromeda and the Milky Way Doomed to Collide? Maybe Not

Scientists discovered the Andromeda galaxy, known as M31, hundreds of years ago, and around a century ago, we realized that it had negative radial velocity toward the Milky Way. In other words, eventually, the two galaxies would merge spectacularly. That has been common knowledge for astronomers since then, but is it really true? A new paper from researchers at the University of Helsinki looks at several confounding factors, including the gravitational influence of other galaxies in our local group, and finds only a 50% chance that the Milky Way will merge with the Andromeda galaxy in the next 10 billion years.

That seems like a pretty big thing to get the physics wrong on. So, how did the authors come to that conclusion? They accounted for a problem that has been popularized in media as of late – the three-body – or in this case, four-body – problem. And with that problem comes a lot of uncertainty, which is why there's still a 50% chance that this huge event might still happen.

Thinking of Andromeda and the Milky Way in isolation doesn't account for the other galaxies in what we know as the "Local Group." This comprises approximately 100 smaller galaxies at various orientations, distances, and speeds. The largest of the remaining galaxies is the Triangulum galaxy, M33, which is about 2.7 million light-years away and consists of upwards of a mere 40 billion stars. That's about 40% of the approximately 100 billion stars in the Milky Way but a mere 4% of the nearly 1 trillion stars estimated to exist in Andromeda. Still, they would have their own gravitational pull, contorting the simplistic dynamic between Andromeda and the Milky Way.

Further confounding that dynamic is the Large Magellanic Cloud, which is either the second or third closest galaxy to our own at a distance of only 163,000 light years. This is slightly larger than the Milky Way's diameter, at

105,700. It also houses around 20 billion stars, so while it's even less massive than M33, it still exerts a hefty gravitational pull.

The authors accounted for the gravitational pull of both of those other galaxies in their calculations of the paths of the Milky Way and Andromeda over the next few billion years. They found that the complicated dance of astronomical giants could potentially result in a scenario where the two galaxies don't merge. However, there was another significant factor in their calculations: uncertainty.

Scientists never like uncertainty. In fact, much of their research tries to place bounds on certain parameters, like the rotational speed of galaxies or the distances between them. Unfortunately, despite their proximity, there are many uncertainties surrounding the four galaxies used in the study, and those uncertainties make precise calculations of the effects of their gravitational and rotational pull difficult.

Fraser discusses what stars, if any, we can see in Andromeda.

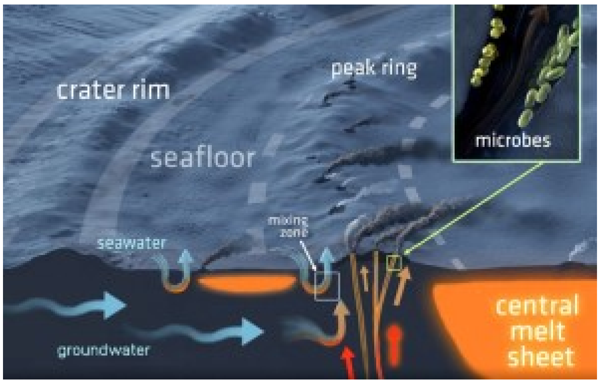
Developing estimates rather than concrete numbers is one-way scientists often deal with uncertainty, and in this case, that estimate fell right at the 50% mark in terms of whether or not the two galaxies would collide. However, there is still a lot of uncertainty in that estimate, and plenty more confounding factors, including the other galaxies in the local group, will influence the final outcome. Ultimately, time will help solve the mystery, but that is a very long time on the scale of galaxy mergers. If it happens at all, a merger between the Milky Way and Andromeda will happen long after our own Sun has burnt out, and humans will either die out with it or find a way to expand to new stars. And if, at that point, we get easy access to an additional galaxy's worth of resources, it would be all the better for us.

Learn More:
Sawala et al. – Apocalypse When? No Certainty of a Milky Way — Andromeda Collision
UT – Are Andromeda and the Milky Way Already Exchanging Stars?
UT – What a Mess. When the Milky Way and Andromeda Merge, it'll Look Like This
UT – We Might Be Able to Measure Dark Energy Through the Milky Way's Collision With Andromeda

A Surprising Source of Oxygen in the Deep Sea

I have always found Mariana's Trench fascinating, it's like an alien world right on our doorstep. Any visitor to the oceans or seas of our planet will hopefully get to see fish flitting around and whilst they can survive in this alien underwater world they still need oxygen to survive. Breathing in oxygen is a familiar experience to us, we inflate our lungs and suck air into them to keep us topped up with life giving oxygen. Fish are different, they get their oxygen as water flows over their gills. Water is full of oxygen which at the surface comes from the atmosphere or plants. But deep down, thousands of meters beneath the surface, it is not so easy. Now a team of scientists think that potato-sized chunks of metal called nodules act like natural batteries, interacting with the water and putting oxygen into the deep water of the ocean.

Thanks to robotic underwater explorers the sight of life teeming around thermal vents on the bottom of the deep ocean is not unusual. At those depths, no sunlight can penetrate to facilitate photosynthesis in plants. Somehow though, oxygen is present in the dark, deep regions of the ocean and its the rocks that a team of scientists led by Andrew Sweetman have been exploring.



A Three-dimensional cross-section of the hydrothermal system in the Chicxulub impact crater and its seafloor vents. The system has the potential for harboring microbial life. Illustration by Victor O. Leshyk for the Lunar and Planetary Institute.

The production of oxygen by plants is well understood. Light is captured by a pigment known as chlorophyll where it is then converted into chemical energy and stored in the glucose. During photosynthesis, carbon dioxide from air and water from soil are combined in a series of chemical reactions to produce glucose and oxygen that we use to breathe. This oxygen from the plants plays a role in maintaining levels in the atmosphere and the oceans and seas. The study challenges this somewhat simplified explanation.

The team focussed on measuring how much oxygen was being consumed by organisms in the depths of the ocean. Water sampled from the deep showed a surprising rise in oxygen levels instead of an anticipated decline. The study was repeated a few years later from the same location in a study commissioned by a mining company. Again they saw a rise in oxygen levels. Clearly something in the deep ocean was creating oxygen, but what?

Lab tests ruled out the possibility of microbes but the region being studied was peppered with lumps of rock known as polymetallic nodules. The nodules are known to form when manganese and cobalt precipitate out of water and form around shells. The nodules where theorised to be the source of the oxygen but the mechanism was not understood.

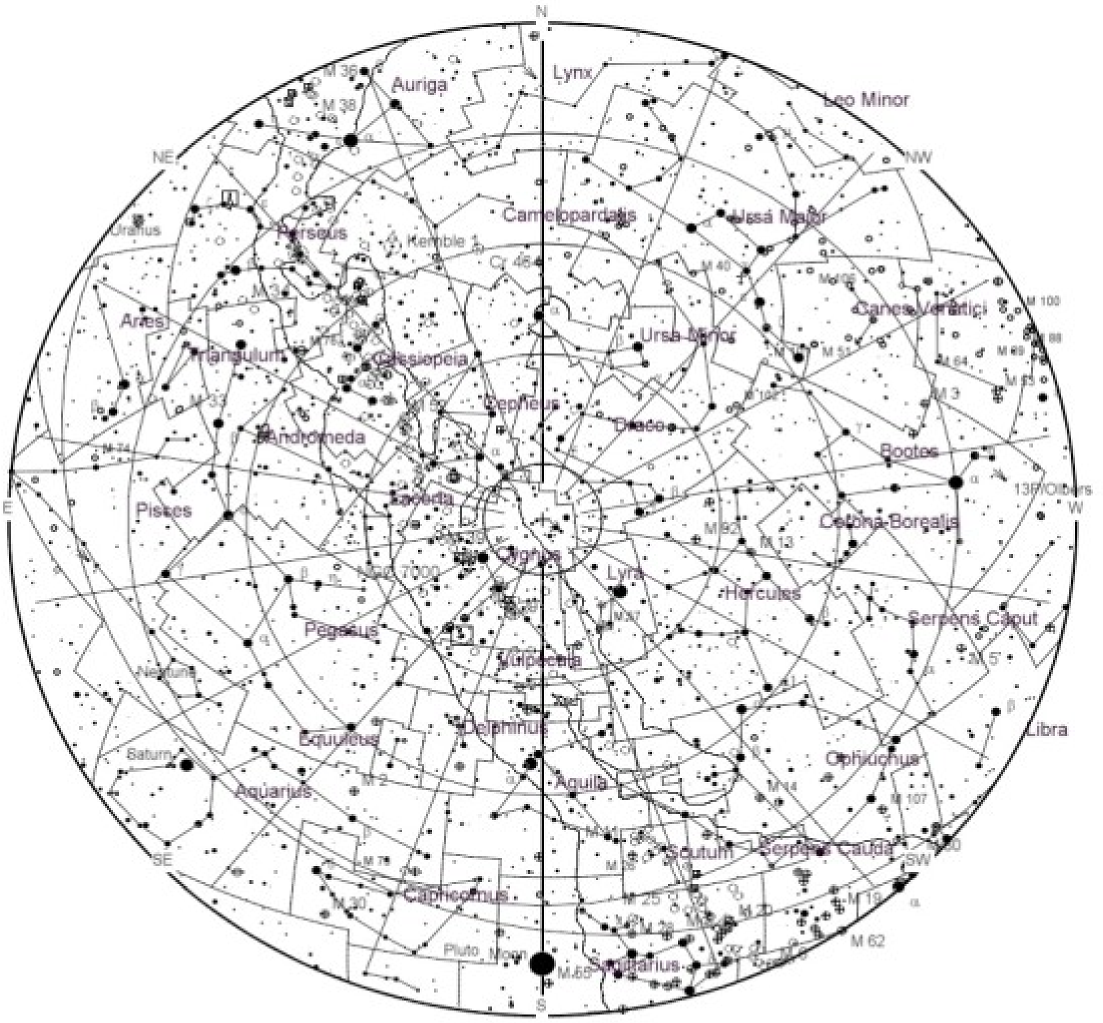
The answer came when Sweetman heard a reporter calling the nodules 'a battery in a rock'. Putting batteries in saltwater results in bubbles of hydrogen and oxygen which is the result of a process known as electrolysis. The team measured the voltage on the nodules and found just one of them to be 0.95 volts – a little lower than the required 1.5 volts for saltwater driven electrolysis but the team were onto something, suspecting multiple rocks could cluster together to increase voltage.

The discovery of rocks on the bottom of the ocean generating oxygen is fascinating on its own but it has profound impacts on the search for life elsewhere in the universe. We have already discovered ice covered water worlds among the moons around some of the outer planets. It's likely there will be others in planetary systems around other stars. If these worlds are common then it is quite likely that oxygen is being released through electrolysis from similar metallic nodules and perhaps, supporting entire ecosystems.

Source : Evidence of dark oxygen production at the abyssal seafloor

WHATS UP, SEPTEMBER 24

Alt/Az coord. ARC
Apparent
Home
2024-09-13
21h30m00s (BST)
Mag:6.1/10.5,2.6'
FOV:+285°05'12"



September 3 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 01:57 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

September 5 - **Mercury at Greatest Western Elongation.** The planet Mercury reaches greatest western elongation of 18.1 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the morning sky. Look for the planet low in the eastern sky just before sunrise.

September 8 - **Saturn at Opposition.** The ringed planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Saturn and its moons. A medium-sized or larger telescope will allow you to see Saturn's rings and a few of its brightest moons.

September 18 - **Full Moon, Supermoon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 02:36 UTC. This full moon was known by early Native American tribes as the Corn Moon because the corn is harvested around this time of year. This moon is also known as the Harvest Moon. The Harvest Moon is the full moon that occurs closest to the September equinox each year. This is also the first of three supermoons for 2024. The Moon will be near its closest approach to the Earth and may look slightly larger and brighter than usual.

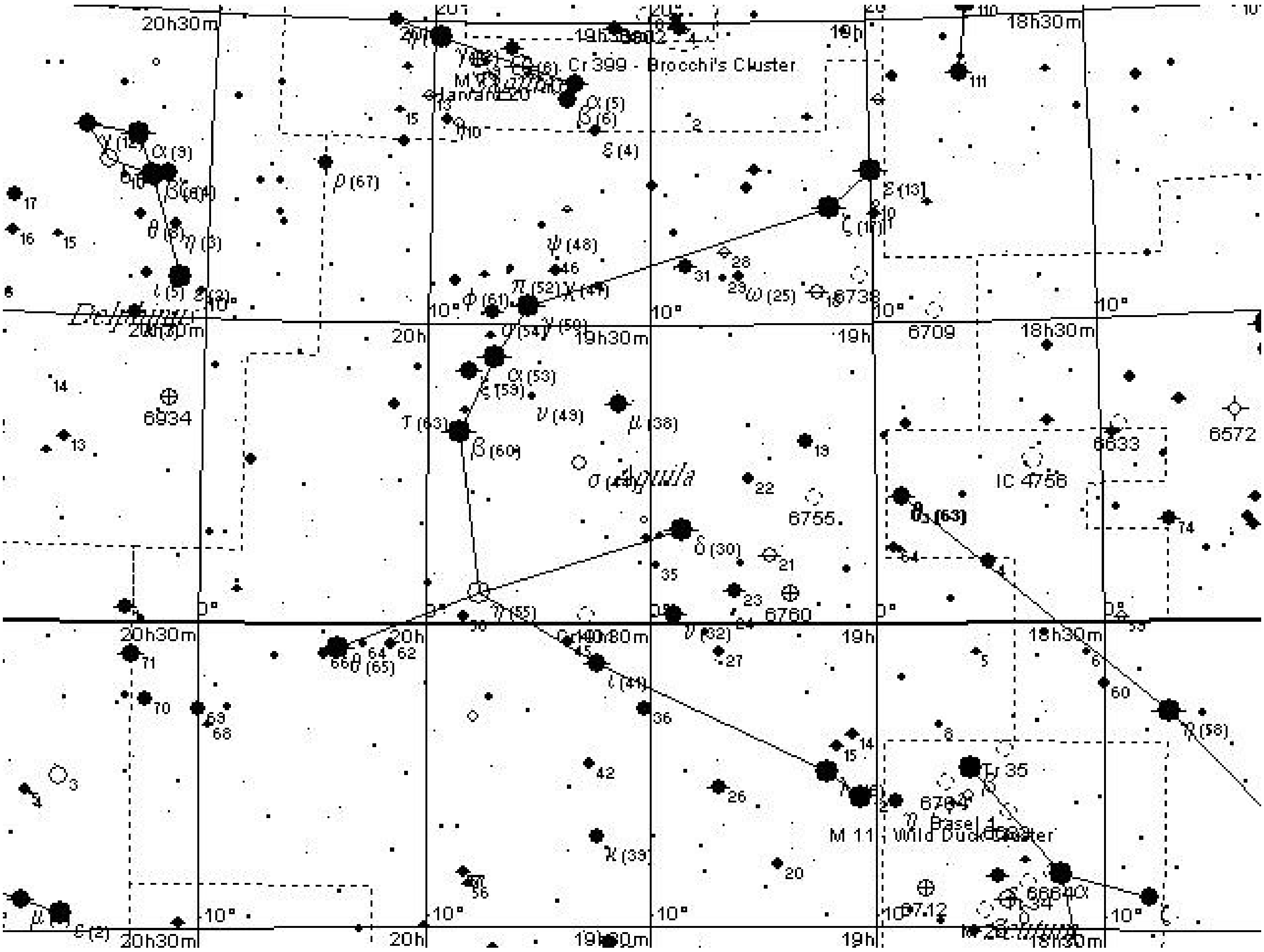
September 18 - **Partial Lunar Eclipse.** A partial lunar eclipse occurs when the Moon passes through the Earth's partial shadow, or penumbra, and only a portion of it passes through the darkest shadow, or umbra. During this type of eclipse a part of the Moon will darken as it moves through the Earth's shadow. The eclipse will be visible throughout most of North America, Mexico, Central America, South America, the Atlantic Ocean, and most of Europe and Africa. (**NASA Map and Eclipse Information**)

September 20 - **Neptune at Opposition.** The blue giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Neptune. Due to its extreme distance from Earth, it will only appear as a tiny blue dot in all but the most powerful telescopes.

September 22 - **September Equinox.** The September equinox occurs at 12:39 UTC. The Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world. This is also the first day of fall (autumnal equinox) in the Northern Hemisphere and the first day of spring (vernal equinox) in the Southern Hemisphere.

October 2 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 18:51 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

CONSTELLATION OF THE MONTH: AQUILLA



In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) released one of the most influential books in the history of astronomy. Known as the *Almagest*, this book included the 48 then-known constellation into a system of cosmology that would remain influential for over a thousand years. Among the 48 constellations listed in this book was Aquila, a constellation in the northern sky that extends across the celestial equator.

Also known as the “Eagle”, this constellation is one of the 88 constellations that is recognized today by the International Astronomical Union (IAU). It belongs to the Hercules family of constellations, which include Ara, Centaurus, Corona Australis, Corvus, Crater, Crux, Cygnus, Hercules, Hydra, Lupus, Lyra, Ophiuchus, Sagitta, Scutum, Serpens Caput, Serpens Cauda, Sextans, Triangulum Australe, and Vulpecula.

Name and Meaning:

Aquila takes it name from the Latin word for “Eagle”. According to classic Greek mythology, Aquila was the eagle that carried the thunderbolts of Zeus. He was also sent to retrieve the Trojan shepherd boy – Ganymede, whom Zeus desired – to become a wine-pourer for the gods. Aquila’s proximity to Aquarius, which represents Ganymede, is one of the reasons why the constellation is so-named.

In another story, the eagle is found guarding the arrow of Eros (represented by the constellation Sagitta), which hit Zeus and made him love-struck. In yet another, Aquila represents Aphrodite disguised as an eagle, pretending to pursue Zeus in the form of a swan. This she did so that Zeus’ love interest, the goddess Nemesis, would give him shelter.

Zeus later placed the images of the eagle and the swan (the constellation Cygnus) among the stars to commemorate the event. Aquila may also represent one of the twelve labors of Hercules.

History of Observation:

Though it one of the 48 constellations included by Ptolemy in the *Almagest*, the first recorded mention of Aquila that still survives come from Eudoxus of Cnidus – a Greek astronomer and student of Plato’s during the 4th century BCE – and Aratus, the didactic poet who wrote of the constellations in the 3rd century BCE.

It is also believed that the Greek version of the Aquila constellation is based on the Babylonian constellation of MUL.A.MUSHEN), which occupied the same spot in the northern sky. The constellation was also known as *Vultur volans* (the flying vulture) to the Romans, which is not to be confused with *Vultur cadens* – their name for Lyra.

Ptolemny was also responsible for cataloging 19 stars in the Aquila constellation and the now obsolete constellation of Antinous. These stars are sometimes erroneously attributed to Tycho Brahe, who later catalogued the same stars, but identified 12 as belonging in Aquila and 7 in Antinous. Ultimately, it was 17th century Polish astronomer Johannes Hevelius who determined the 23 stars in Aquila and 19 in Antinous.

Notable Features:

Aquila's alpha star – Altair, which is translated from the Arabic *al-nasr al-tair* ("flying eagle") – is located 17 light-years from Earth. This star rotates very rapidly (286 km/s), which is what gives Altair it's shape – i.e. flattened at the poles. Beta Aquilae (aka. Alshain) is a yellow-hued star of magnitude 3.7 is located 45 light-years from Earth. Its name comes from the Arabic phrase "shahin-i tarazu", meaning "the balance".

Gamma Aquilae is an pranged-hued giant star of magnitude 2.7 which is located 460 light years away. It's name, like Alshain, comes form the Arabic term for "the balance". Whereas Altair is one of the three stars that form the Summer Triangle – an asterism that can be seen directly overhead at mid-northern latitudes in the summer – Alshain and Tarazed form the wings of the eagle.

According to SEDS, two major novae have been observed in Aquila. The first one was in 389 AD and was recorded to be as bright as Venus. The other shone brighter than Altair, the brightest star in the Aquila constellation. Two major novae have been observed in Aquila – the first one being in 389 BCE that was recorded as being as bright as Venus – and the other in 1918 (Nova Aquilae 1918), which briefly shone brighter than Altair.

The Glowing Eye of Planetary Nebula NGC 6751. Credit: NASA/Hubble Heritage Team/STScI/AURA

The constellation is also home to several Deep Sky Objects. Foremost amongst these is NGC 6751, a planetary nebula that is also known as the Glowing Eye. The nebula is estimated to be around 0.8 light-years in diameter and is estimated to be roughly 6,500 light-years away from Earth. It was formed when a star collapsed and threw off its outer layer of gas several thousand years ago.

The nebula was the subject of the winning picture in the 2009 Gemini School Astronomy Contest, in which Australian high school students competed to select an astronomical target to be imaged by the Gemini Observatory.

Finding Aquila:

The constellation of Aquila is easily recognized as a small cruciform configuration east of the Milky Way. For those using binoculars, those looking for Aquila should first look at Altair. It's the twelfth brightest star in the sky. A groundbreaking study with the Palomar Testbed Interferometer revealed that Altair is not spherical, but is rather flattened at the poles due to its high rate of rotation.

Synthetic aperture techniques with multiple optical telescopes have imaged this phenomenon. Located on 17 light years away from Earth, this Delta Scuti type variable spins completely on its axis in a matter of about 6 hours and 30 minutes. Now compare it to Gamma – Tarazed – which is about 460 light years from here. It is a giant star with a diameter of approximately half an AU.

Altair, the brightest star in the constellation Aquila and the twelfth brightest star in the nighttime sky. Credit: starrynightphotos.com

Now, here's something you can study – Eta Aquilae. Eta is one of the brightest of the Cepheid variables, ranging from magnitude 4.1 to magnitude 5.3 every 7.2 days. It is a super giant star about 3400 times more luminous than the Sun, located 1200 light years from our solar system.

For both binoculars and small telescopes, try double star 57 Aquilae (located about 15 degrees south or less than a handspan from Eta). This is a very cool matched pair of stars of equal 6th magnitude brightness separated by about 36 arc seconds. Check out R Aquilae, too. It's a Mira-type variable. It takes about 300 days to go through its changes but at its peak it's about 200 times brighter than our Sun. R is visible with the unaided eye at maximum brightness and its magnitude ranges from 5.5 to 12 every 284 days exactly.

Now, get out the telescopes and let's go for some binary stars. First, Beta Aquilae – Alschain. Located almost 45 light years away and shining at magnitude 3.7, you'll find its disparate 12th-magnitude companion 12.8 arc seconds away. Now try Zeta Aquilae, a much more difficult double star located about 83 light years away. The primary star is a 3rd magnitude white dwarf and its companion is a disparate 12th -magnitude found 6.5 arc seconds from the primary.

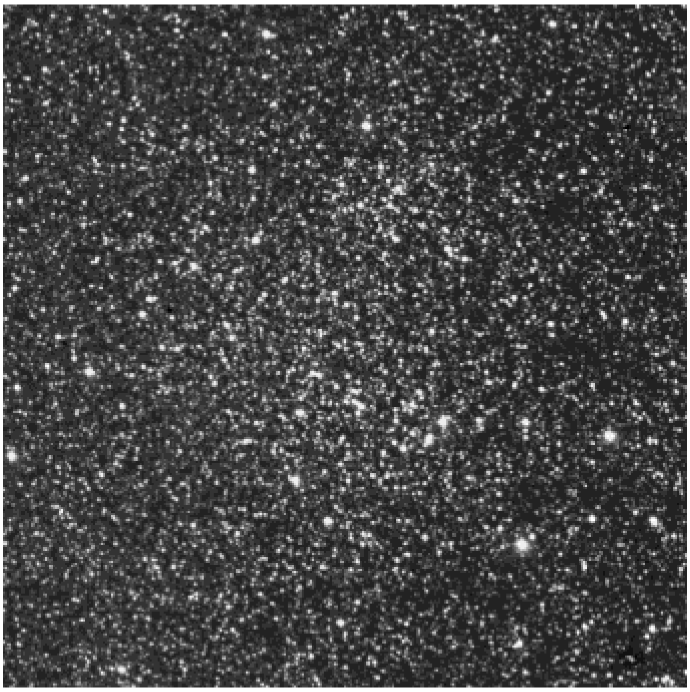
And then there's Pi Aquilae, a double star easily resolved with a 6-inch telescope into its two components of magnitudes 6 and 7, separated by 1.4 arc seconds. More? Try 15 Aquilae. Star 15 is a yellow 5th-magnitude giant with a 7th-magnitude companion positioned 40 arc seconds away. It can easily be observed with small telescopes.

The NGC 6709 open cluster, part of the Aquila constellation (taken from Stellarium). Credit: Wikipedia Commons/ Roberto Mura

If you're looking for some great deep sky objects, why not try some Barnard Dark nebula? E.E. Barnard classed these great objects, and with just a little practice, you can learn to see "nothing", too! Head about a degree and a half west of Gamma for B143 and B144. Here you will find a large patch of nothing that will stand away from the starry fields. It covers about a full degree of sky, so use a wide field eyepiece and low magnification.

If you're looking for something a bit brighter, let's try some open clusters for the telescope. Find Zeta and go about five

degrees southwest for NGC 6709. It's a nice compressed star field of about 30 stars covering an average diameter of about 15 arc minutes. Located about 5 degrees west of Delta you'll



find NGC 6755, another small open cluster. At low magnification, it's not very well resolved, but up the magnification and you'll find about a dozen faint stars as your reward.

For large telescopes, look for NGC 6760. This globular cluster is roughly magnitude 10 and about 5 arc minutes in size. Or try 12th magnitude planetary nebula NGC 6751 – the "Glowing Eye". Other notable planetary nebula include NGC 6804, NGC 6778, NGC 6741, NGC 6772 and NGC 6804 discovered by Sir William Herschel. It's a nice bright one which exhibits some evidence of an interaction with the interstellar medium, along with a characteristic central torus and outer halo

ISS PASSES For Summer 2024

from Heavens Above website maintained by Chris Peat.

Date	Brightness	Start	Highest point	End	Pass type					
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
05 Sep	-3.8	19:07:33	10°	SSW	19:10:49	56°	SE	19:10:52	56°	ESE
06 Sep	-2.5	18:20:18	10°	S	18:23:00	23°	SE	18:25:42	10°	ENE
06 Sep	-0.4	19:58:51	10°	WNW	19:59:35	11°	NW	19:59:52	10°	NW
07 Sep	-1.3	19:09:01	10°	WSW	19:11:43	23°	NW	19:14:25	10°	N
08 Sep	-3.0	18:20:35	10°	SW	18:23:50	56°	NW	18:27:04	10°	NNE
10 Sep	-2.0	05:08:48	10°	NNW	05:11:54	34°	NE	05:15:00	10°	ESE
10 Sep	-0.4	18:23:29	10°	WNW	18:24:30	11°	NW	18:25:31	10°	NW
11 Sep	-0.7	04:21:49	10°	NNE	04:23:53	15°	NE	04:25:59	10°	E
12 Sep	-3.2	05:09:46	13°	WNW	05:12:25	38°	SW	05:15:36	10°	SSE
05 Oct	-1.6	19:22:57	10°	NNW	19:24:04	20°	NNW	19:24:04	20°	NNW
06 Oct	-2.9	18:34:15	10°	N	18:37:12	30°	NE	18:38:37	21°	E
07 Oct	-1.1	19:22:07	10°	WNW	19:24:34	19°	SW	19:26:22	13°	SSW
08 Oct	-2.7	18:32:12	10°	NW	18:35:24	46°	SW	18:38:37	10°	SSE
10 Oct	-2.1	05:18:33	10°	SSW	05:21:41	37°	SE	05:24:47	10°	NE
10 Oct	-0.2	18:32:52	10°	WSW	18:33:28	10°	SW	18:34:04	10°	SW
11 Oct	-0.7	04:30:16	10°	SSE	04:32:24	16°	SE	04:34:33	10°	E
12 Oct	-3.2	05:16:29	10°	WSW	05:19:35	36°	NW	05:22:40	10°	NNE

END IMAGES, AND OBSERVING

Corona Borealis Nova. At the time of writing the T CrB 80 year repeating nova is still waiting to erupt. I have been imaging every clear night since July, despite smoke from American forest fires and even volcanic enissions from Icelandic eruption blowing through our upper atmosphere. Nikon D810a 85mm lens at f2.8 and 30 second exposures. I have zoomed into the region to the left of Eta CrB to show the expected star, here at about 10.4 magnitude. Andy

Wiltshire Astronomical Society Planned Observing Evenings 2024-2025 Season

(green)	First Attempt	(yellow)	Second Attempt		
Date		**Time**	**Planets and Events**	**Meteor Showers**	**Moon Status**
September					
Friday	06/09/2024	21:00	Saturn in Oposition	None	Waxing Crescent
Friday	27/09/2024	20:30	Saturn	None	Last Quarter/Waining Crescent
October					
Friday	04/10/2024	20:00	Saturn, Uranus	Draconids	New
Friday	25/10/2024	20:00	Jupiter, Saturn, Uranus, Neptune in Oposition,	Orionids	Last Quarter/Waining Crescent
November					
Friday	01/11/2024	19:30	Jupiter, Saturn, Uranus,		New
Friday	22/11/2024	19:00	Jupiter, Saturn, Uranus in Oposition	Leonids	Last Quarter/Waining Crescent
Friday	29/11/2024	19:00	Jupiter, Saturn, Uranus,	Leonids	New
December					
Friday	20/12/2024	19:00	Venus, Mars, Jupiter, Saturn, Uranus,	None	Waining Gibbous
Friday	27/12/2024	19:00	Venus, Mars, Jupiter, Saturn, Uranus,	None	Last Quarter/Waining Crescent
January					
Friday	24/01/2025	19:00	Venus, Mars, Jupiter, Saturn (low), Uranus,	None	Last Quarter/Waining Crescent
Friday	31/01/2025	19:30	Venus (low), Mars, Jupiter, Saturn (low), Uranus,	None	New
February					
Friday	21/02/2025	19:30	Venus (low), Mars, Jupiter, Uranus,	None	Last Quarter
Friday	28/02/2025	19:30	Venus (low), Mars, Jupiter, Uranus,	None	New
March					
Friday	21/03/2025	20:00	Mars, Jupiter, Uranus,	None	Last Quarter
Friday	28/03/2025	20:00	Mars, Jupiter,	None	New
April					
Friday	18/04/2025	20:30	Mars, Jupiter,	Lyrids	Last Quarter/Waining Crescent
Friday	25/04/2025	21:00	Mars, Jupiter (low),	Lyrids	Waining Crescent
May					
Friday	23/05/2025	21:00	Mars, Jupiter (low),	None	Waining Crescent
Friday	30/05/2025	21:00	Mars,	None	New

Observing Area - Picnic Area to the side of the Red Lion Pub carpark SN15 2LQ (W3W = airbag.shudders.losing)