NWASNEWS

Volume27 Issue 3

NOVEMBER 2021

Newsletter for the Wiltshire, Swindon, Beckington, Bath Astronomical Societies

Back to Zoom Meetings for a while

Our committee have decided to move our hall meetings to Zoom meetings until at least April.

The local Covid 19 situation is worse in the area than the rest of the UK, with a new variant about too. Inside meetings are difficult so we have agreed with speakers to move to Zoom. Our numbers attending have been lower than normal, less than half, and the costs of the hall and speakers is nowhere close to being covered by attendance fee. While we have the funds to keep going it would only take two years of this attendance level and we would have to close the society. It is much better that we go to Zoom and survive.

At the moment our observing sessions are going ahead, but sharing equipment is restricted because cleaning chemicals will ruin eyepieces etc.

It is not only us in this predicament and several local societies are making the same decision, and even the FAS have had to have on emergency meeting on line following the AGM not having a quorum of committee members to pass any resolutions. I am sorry in many ways because I do like the social side of the society, but I feel this is better for the long term success of the society.

One advantage of Zoom meetings has raised its head today as our speaker has contacted me at lunchtime and had to put off her talk tonight following a bereavement in her family.

I will open the meeting to catch anybody who misses this and discuss events and viewing/imaging challenge for this week end that you may like to take part in.

Then I will rearrange a meeting for next Tuesday, 9th November for our speaker. The beauty is that this will not cost the society any extra funds.

Please note this month's letter from La Palma!

Andy Burns Wiltshire AS Zoom Meeting

Time: Nov 2, 2021 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/89778910858?pwd=QVNNbW14UkhUNXh2cmthRm9lNHY4QT09

Meeting ID: 897 7891 0858

Passcode: 833830

Please note the full speaker meeting will go ahead NEXT week on the 9th November. It will have different ID and Passcode.

Topic: Andy Burns' Zoom Meeting rearranged

Time: Nov 9, 2021 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/89401275309?pwd=dlFoQUY1eXBRNEdObFAwZXBobjlDZz09

Meeting ID: 894 0127 5309

Passcode: 296206

Clear skies Andy

The **Alpha Persei Cluster**, also known as **Melotte 20** or **Collinder 39**, is an open cluster of stars in the northern constellation of Perseus. To the naked eye, the cluster consists of several blue-hued spectral type B stars. The most luminous member is the ~2nd magnitude white-yellow supergiant Mirfak, also known as Alpha Persei. Bright members also include Delta, Sigma, Psi, 29, 30, 34, and 48 Persei.
The Hipparcos satellite and infrared color-magnitude diagram fitting have been used to establish a distance to the cluster of ~560 light-years (172 pc). The distance established via the independent analyses agree, thereby making the cluster an important rung on the cosmic distance ladder. As seen from the Earth, the extinction of the cluster due to interstellar dust is around 0.30. Andy Burns 30secs.

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

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

Meetings 2020/2021.

HALL VENUE the Pavilion, Rusty Lane, Seend

Some Speakers have requested Zoom Mweetings and these will be at home sessions.

Meet 7.30 for 8.00pm start

SEASON 2020/21

2021

9th Nov Katrin Raynor-Evans Exploring Astronomy through Philately (Zoom)

7th Dec Paul Money Trials & Tribulations of Voyager (Zoom)

2022

4th Jan Martin Lunn The Star of Bethlehem (Zoom)

1st Feb Prof David Southwood TBN (Zoom)

1st Mar Martin Griffiths Dark Energy and Matter (Zoom)

5th Apr Pete Williamson Herschel to Hawkwind, Astronomy & Music & How each other influence each other

3rd May Andrew Lound The Moon at Christmas: The Epic Voyage of Apollo 8

7th Jun Prof Matt Griffin The hazards of Asteroid Impacts on the Earth – Should we worry?

Katrin Raynor=Evans FRAS and FRGS, Menber of the European Astronomical Society and of course, the Cardiff Astronomical Society.

I would hasten to add the Katrin is way more than a stamp collector! If you pich up the Astronomy 2022 Yearbook you will see she has no less than two articles in this year's edition. Stamps yes, but also a review of the unusual observatory dome design at the Mills Observatory giving away her roots up in Dundee Scotland,

She is a freelance writer for many popular astronomy magazines including the BBC Sky at Night, and covers many topics including observing Deep Sky Objects, the Beddgelert Meteorite, Astronomy for Everyone and numerous book reviews.

She has also written for international magazines Physics Today, and conducted many eminent astronomers.

I keep bumping into her all over the place, the National Museum in Cardiff, at the Cardiff Society when I have been giving talks there and several times up in the Brecons when I am working with Dark Skies Wales.

Thank Katrin for giving us our talk tonight.

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

Andy Burns Chair, anglesburns@hotmail.com

Andy Burns Outreach and newsletter editor.

Bob Johnston (Treasurer)

Philip Proven (Hall coordinator)

??? (Teas and Projector)

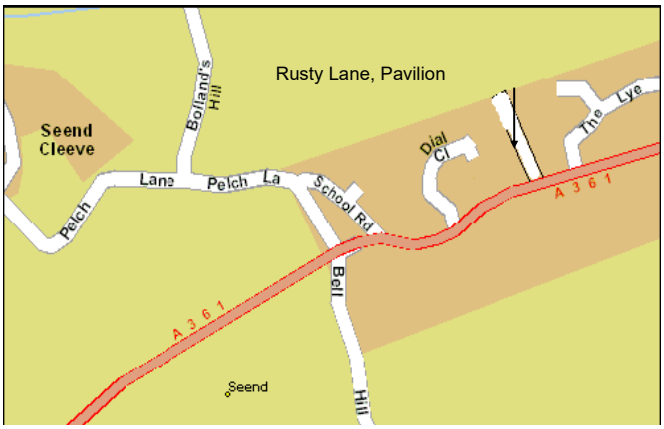
Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

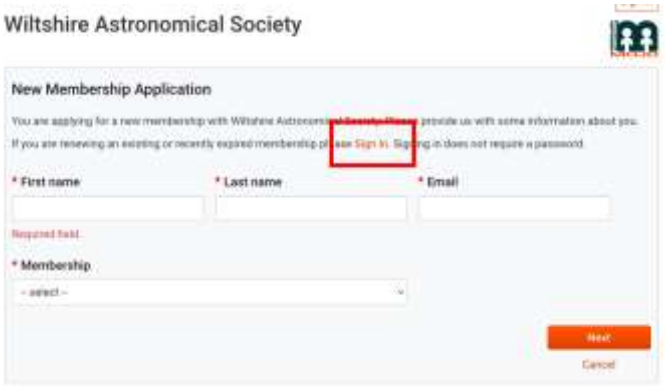
Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



Observing Sessions see back page



Swindon's own astronomy group

Physical meetings continuing!

Following the relaxation of the Covid rules we continuing physical meetings.

Next meeting: Mark Radice

Mark lives near Salisbury and has been active in Astronomy since watching Comet Hykutake cross the sky while working in Canada in 1996. This sparked off an interest that led him across the moon, through the solar system and out into deep space.

He enjoys visual observing, sketching, lunar and planetary imaging, solar observing and wide field photography. He is a generalist as he enjoys observing anything that is in the sky!

When he is not using his observatory, he can be found under the dark skies of Salisbury Plain with the Salisbury Plain Observing Group (SPOG); or on Tenerife at the Mons Observatory.

Ad-hoc viewing sessions postponed

All ad-hoc meetings are currently cancelled until further notice.

Regular stargazing evenings are being organised near Swindon. To join these events please visit our website for further information.

Lately we have been stargazing at Blakehill Farm Nature Reserve near Cricklade, a very good spot with no distractions from car headlights.

We often meet regularly at a lay-by just outside the village of Uffcott, near Wroughton. Directions are also shown on the website link below.

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

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 on our website at:

http://www.swindonstargazers.com/clubdiary/directions01.htm

Meeting Dates for 2021

Friday 15 October 19.30 onwards - Meeting in person

Programme: Charles Barclay: Oldest GOTO telescope in the World.

Friday 19 November 19.30 onwards - Meeting in person

Programme: Mark Radice: Deep Sky Observing

Friday 10 December 19.30

Programme: Christmas Social

Meeting Dates for 2022

Friday, 21 January 19.30 onwards - Meeting in person

Programme: TBA

Website:
http://www.swindonstargazers.com

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http://www.swindonstargazers.com

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BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Website www.beckingtonas.org

General enquiries about the Society can be emailed to chairman@beckingtonas.org.

Our Committee for 2016/2017 is

Chairman: Steve Hill (email chairman@beckingtonas.org)
Treasurer: John Ball
Secretary: Sandy Whitton
Ordinary Member: Mike Witt

People can find out more about us at www.beckingtonas.org

Meetings take place in Beckington Baptist Church Hall in Beckington Village near Frome.

See the location page for details of how to find us on our website……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm No hall meetings.

STAR QUEST ASTRONOMY CLUB

This young astronomy club meets at the

Sutton Veny Village Hall.

Second Thursday of the Month.

Meet at Sutton Veey near Warminster.

BATH ASTRONOMERS

Bath Astronomers are holding webinar sessions linking in with Stargazers web sight.

Simon at Bath Astronomers has sent the following information. An afternoon of “Extreme Stellar Environments” is yours on the afternoon of Saturday 13th November comprising 4 online talks on this theme from respected astronomy professionals focussing on their specific interests from supernovae, neutron stars, zombie stars to black holes. Guiding us through this journey of cataclysm and atom wrenching adventure is Dr Robert Massey, Deputy Executive Director of the Royal Astronomical Society.
Organised jointly by Bath Astronomers, Bristol Astronomical Society, and Cardiff Astronomical Society, this free Zoom event runs from 1:30pm to 5:30pm and is open to all. It just requires you to register your place in advance to avoid the disappointment of your name not being down. Simply visit https://www.eventbrite.co.uk/e/extreme-stellar-environments-tickets-169977235487 to secure your spot.
The talks are as follows:
Supernovae by Dr Philip Wiseman, Southampton University
Supernovae are the explosive ends to stars’ lives and are some of the most powerful and energetic events in the Universe. Despite having been observed by humans at least as long ago as the 11th Century, it is only in the last few decades that we have begun to discover the true diversity of stellar deaths that pervade the night sky. In this talk I will outline the different routes to forming a supernova and how those differences change their appearance. I’ll describe the process of observing supernovae on a mass scale, and will highlight how this has led to some of the strangest and unexplained phenomena still puzzling astronomers today.
Stellar Black holes by Dr Vivien Raymond, Cardiff University
Black holes are some of the strangest, most puzzling objects in the Universe. They deform space and time to extremes, and for the longest time could only be observed indirectly via their effect on their environment. However, we are now capable of listening to the very space-time deformation they produce. In this talk I will present how we study those invisible objects with gravitational-wave observatories, and what we can learn from them.
How we study neutron stars by Dr Diego Alamarino, Southampton University
Neutron Stars are the most compact objects in the Universe where we can still see a surface. They are tiny 30km diameter spheres lost in the immense sky. So how is it that astronomers are able to study them? In this talk I will summarize some of the techniques used to study those Neutron Stars that interact with their nearby environments
The extreme physics of zombie stars by Professor Nils Andersson, Southampton University
A neutron star is born when a massive star runs out of nuclear fuel and dies in a supernova explosion. The object that emerges when the dust settles – effectively a zombie star – involves physics at the extremes of our understanding (and beyond). In this talk, I will explain how we are using astrophysical observations (both electromagnetic and through gravitational waves) to explore this physics and make progress on a range of challenging questions

LETTER FROM LA PALMA
November 2021

Mike Alexander

Image of a lonely house at the foot of the Cumbre Vieja volcano / Twitter David de la Iglesia (@DIVCreativo)

I'm sure it can't have escaped your notice that we have a slight problem on the island, at the moment. We were sitting having a late lunch at El Balcón, one of my favourite restaurants on Sunday 20th.September, down in Tazacorte Harbour, when boom! – a volcano erupted, not something you see every day! It does happen roughly once every 50 years on La Palma, the last events being Teneguia in 1971 and San Juán in 1949. However, this one has proved to be far more destructive than those two eruptions put together. The villages of Todoque, where we once stayed, and the pretty La Laguna have gone forever, with all their homes and businesses, buried under lava, which takes years to cool and many decades before the land can be used again.

Plan to convert ORM fibre optic cabling into a network of sensors to monitor volcano activity

A group of researchers from the Institut de Ciències del Mar (ICM-CSIC), in Barcelona, has coordinated the installation, on the Canary Island of La Palma, of a DAS (Distributed Acoustic Sensing) interrogator device on the fibre optic cabling used by the Roque de los Muchachos Observatory (ORM), of the Institute of Astrophysics of the Canary Islands (IAC). to connect to the Spanish Academic and Research Network (RedIRIS). This instrument will improve the monitoring of seismic activity generated by the eruption of the Cumbre Vieja volcano, which has been active for more than a month, by transforming one of the ORM's fibre optic cables, approximately 8 kilometers long, into a seismic network of thousands of sensors that detect the movement of the terrain.

The interrogator has been developed by the Photonics Engineering Group of the University of Alcalá de Henares (UAH) and the Institute of Optics of the CSIC (IO-CSIC). This instrument uses threads from the fibre cable not used for data transmission (known as dark fiber) to carry out the measurements, while the other wires are used to transmit the seismic signals and quickly distribute them to the National Geographic Institute (IGN) and the Volcanological Institute of the Canary Islands (INVOLCAN), which are the institutions that are carrying out the monitoring of seismic activity in La Palma.

The data acquired with this instrument will complement those obtained by the seismic networks of conventional seismographs currently in operation in La Palma. Also, due to the large number of sensors – one for every 10 metres of cable – provided by the DAS, it will be possible to carry out studies that are difficult using conventional seismographs, such as, for example, determining the location of the volcanic tremor and its change over time

The installation of this instrument in La Palma shows the innovative use of two large scientific infrastructures (ORM and RedIRIS) to respond to the needs of society with applications for which they were not originally designed".

Saturday, 30th.October proved to be a bad day for the Northwest of the island the wind blew the ash cloud from the volcano over the northern areas of Tijarafe, Puntagorda and Garafia including the ORM. The ash is like coarse black sand and believe me, I can tell you from personal experience, it gets everywhere. The domes of the telescopes have remained closed for weeks, halting all nightly observations. This give protection to the mirrors, pointing mechanisms and delicate equipment to most observatories, however, the Cherenkov telescopes, which don't have domes are particularly vulnerable.

The Roque de Los Muchachos Observatory, this Sunday, covered by a dense ash fog from the ANA BEA volcano

Despite the current volcanic issues, life goes at ORM

The Spanish Minister of Science and Innovation, Diana Morant, visited on the facilities of the Centre for Astrophysics in

La Palma (CALP) to be briefed on the impact of the volcanic eruption on the personnel and operation of the facilities present at the Roque de los Muchachos Observatory

To date, there has been no damage to the ORM facilities, although there are telescope personnel who have lost their properties.

In the presence in the air of volcanic ash of an abrasive nature, each of the international institutions present at the Observatory has taken protective measures and has developed safety protocols in order to preserve the expensive optical, electronic and mechanical systems of its telescopes. Among the most damaged infrastructures are the Cherenkov-type telescopes such as the MAGIC and the LST-1 of the Cherenkov Telescope Array (CTA) network. As they do not have domes and remain directly exposed to the fall of volcanic ash, these facilities have had to proceed with the complete closure of operations and have employed additional protective measures for some of their components.

In the case of the GTC and the telescopes of the Isaac Newton Group (ING), these institutions have decided to suspend the observations, but have continued to carry out maintenance and improvement tasks. The remaining telescopes, on the other hand, continue to operate when conditions allow, which is equivalent to about half the observing time they had scheduled. It has not yet been possible to assess in detail the impact on the facilities, especially the most exposed, and that it will be evaluated once the eruption ends.

Minister Morant wanted to send a message of support to the international institutions that have been affected by the current volcanic crisis and assure them that the Ministry of Science and Innovation will continue to support the Observatory and the installation of the new scientific infrastructures that the IAC is promoting in La Palma.

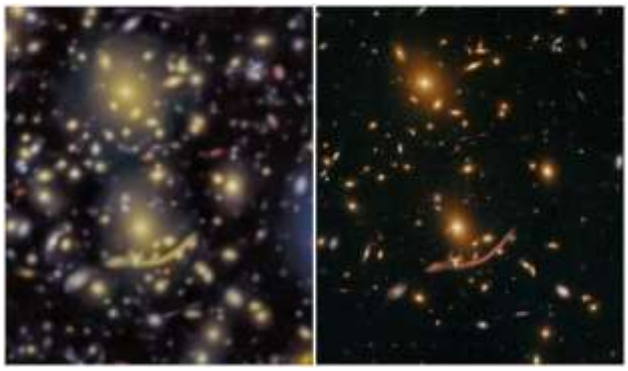
One of the most interesting questions for astrophysicists for the past few decades is how and when did the first galaxies form. One of the possible answers to "how" is that star formation in the first galaxies took place at a steady rate, building up a system with increasing mass. Another possibility is that the formation was more violent and discontinuous, with intense bursts of star formation, on short timescales, triggered by events such as galaxy mergers and strong concentrations of gas.

An international research team, led from the Centre of Astrobiology (CAB, CSIC-INTA) with participation from the Instituto de Astrofísica de Canarias (IAC), in collaboration with researchers form the United Kingdom, Mexico and Chile, have investigated the origin of the first stars and structures in the Universe. They analysed data from the *Frontier Fields* programme, the most ambitious project carried out with the Hubble Space Telescope (HST) and the Gran Telescopio Canarias (GTC or GRANTECAN), the largest optical and infrared telescope in the world, sited at the Roque de los Muchachos Observatory (Garafía, La Palma). The results are published in the journal *Monthly Notices of the Royal Astronomical Society* (MNRAS).

"The first galaxies might have added new stars slowly but continually, without much acceleration, systematically converting gas into relatively small stars over long periods of time. Or the formation could have been in bursts, with short periods of formation producing very big stars, which could shape the whole galaxy and cause it to stop its activity for a while or permanently", explains **Pablo G. Pérez-González,** a researcher at the CAB, a co-author of the article, and leader of the international collaboration working on the study. "Each of the scenarios is linked to different processes, such as the mergers of galaxies or the influence of supermassive black holes, and have an effect on when and how different elements were formed, such as carbon and oxygen, which are essential for life", he adds.

In an article published recently about this subject, the astronomers looked for nearby analogues to the first galaxies formed in the Universe so that they could study them in much greater detail. **Alex Griffiths,** a researcher at Nottingham University and first author on the paper says: "Until we have the new James Webb Space Telescope we will not be able to observe the first galaxies formed in the Universe, they are too faint. So we look for similar objects in the nearby Universe and we analyse them with the most powerful telescopes we have at present".

The way this work was done was to combine the power of the most advanced telescopes, such as the HST and the GTC, with the help of "natural telescopes". **Chris Conselice**, a co-author of the article, and supervisor of the doctoral thesis of Griffiths, comments on this strategy: "Some galaxies are found in large groups, which we call clusters, which contain a large amount of matter in the form of stars, but also in the form of gas and of dark matter. This mass is so big, that it can curve space-time, and the clusters act as "natural telescopes". These, known as gravitational lenses, let us observe distant, faint galaxies more brightly and with better spatial resolution, it is as if we were using a lens created by the Universe itself". Observations of some of these clusters acting as gravitational telescopes are the basis of the *Frontier Fields* project, the most ambitious programme of the Hubble Space Telescope.



This image compares the centre of the cluster as seen with the GTC (left) and with the Hubble Space Telescope (right). The data from the HST have better spatial resolution because they are not affected by the turbulence in the atmosphere. The data from the GTC are even deeper, showing the existence of some galaxies previously unknown and not detected by the HST. Credit: GRANTECAN/HST.

In the study published in MNRAS the authors combined the power of gravitational lensing by some of the most massive clusters in the Universe with very deep images from the GTC taken in the SHARDS project (*Survey for high-z Red and Dead Sources*) with the aim of finding and studying some of the smallest and faintest galaxies in the local Universe.

The SHARDS project consisted in taking with the GTC the very deepest images of the field observed with the Hubble, using 25 intermediate passband filters which together cover the wavelength range from 500 to 940 nanometres. "These selective images allow us to analyse how the light of very faint galaxies is distributed in the different colours of the visible wavelength range. And this allows us to detect the gas heated by newly formed stars, which emit at specific wavelengths (emission lines) in a process similar to that in a neon lamp", explains **Romano Corradi,** the director of GRANTECAN.

"To obtain these images the SHARDS project needed 120 hours of observation with the GTC. The images, which can be combined into a single very impressive image in pseudo colour, are a real mine of information about the thousands of galaxies detected", stresses **Antonio Cabrera**, head of Scientific Operations of GRANTECAN.

"Our main result is that the start of galaxy formation is irregular, with very violent periods of star formation followed by periods when the galaxy is dormant", adds Griffiths. "It is not likely that galaxy mergers played a major role in triggering those bursts of star formation; it is more probable that this was due to other causes which caused the pile-up of gas, we need to investigate further", he concluded.

The Gran Telescopio Canarias and the Observatories of the Instituto de Astrofísica de Canarias (IAC) are part of the network of Singular Scientific and Technical Infrastructures of Spain.

Article: Griffiths et al. “Emission Line Galaxies in the SHARDS Frontier Fields I: Candidate Selection and the Discovery of Bursty Hα Emitters”. *Monthly Notices of the Royal Astronomical Society (MNRAS)*. DOI: https://doi.org/10.1093/mnras/stab2566

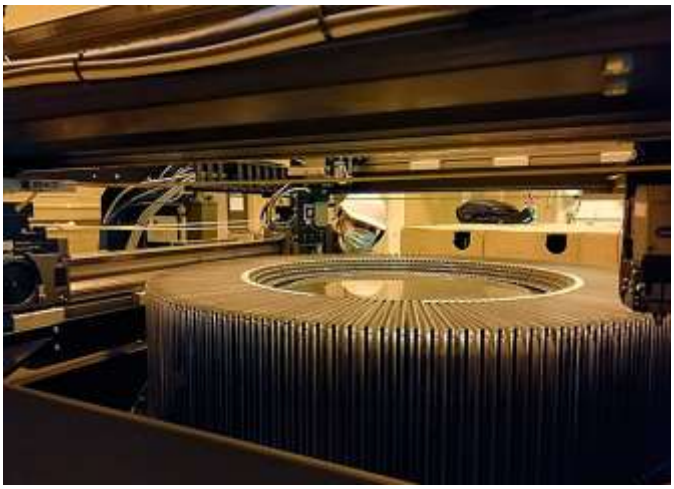
The William Herschel Telescope (WHT) installs a new multi-object spectroscope.

All the main components of the new WEAVE multi-object spectroscope of the WHT located at ORM on La Palma, have already arrived on the island. The project is an international collaboration.

The WEAVE (William Herschel Telescope Enhanced Area Velocity Explorer) spectrograph will expand the telescope’s field of view to two degrees in the sky, or 4 times the apparent diameter of the moon, allowing observations of up to a thousand astronomical objects at once in a programme that will last for the next five years. It will also enable scientists to track sources detected by ESA’s Gaia satellite and study everything from white dwarfs and galaxies that host gravitational wave sources. WEAVE will provide tens of millions of spectra of stars and galaxies over the next 5 years and its mapping will provide data that will help answer questions about the formation of galaxies, including the milky Way and its stars and about the nature of matter and dark energy.

WEAVE has been designed and developed by a large team of scientists and technicians distributed in the UK, Spain, the Netherlands, France, Italy, Hungary and Mexico over ten years. It incorporates many complex moving parts and components developed across Europe.

The commissioning of WEAVE will begin after instrument integration and will last between two and three months, followed by scientific verification observations and routine open -time observations. The first assignments have already been awarded, coming from the International Time Program(me) (ITP) and an open time opportunity announcement will be published once its commissioning has been completed.



WEAVE's fibre positioner after being unpacked at the WHT. In the centre of the image one of the MOS fibre plates can be seen, surrounded by three layers of parked fibre ends and, around these, the fin-like fibre-retractor boxes. Credit: Isaac Newton Group of Telescopes, La Palma.

A fully-configured WEAVE field, with 700 of around 950 fibres placed by two robots (out of frame), on location in the WHT. Large format: JPG. Movies showing the two robots placing the fibres on plate: MP4 (1), MP4 (2). Credit: Gavin Dalton/U. Oxford and STFC's RAL Space

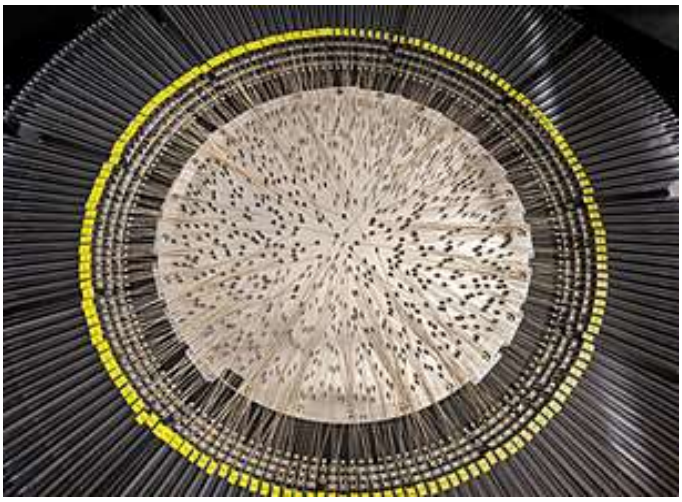
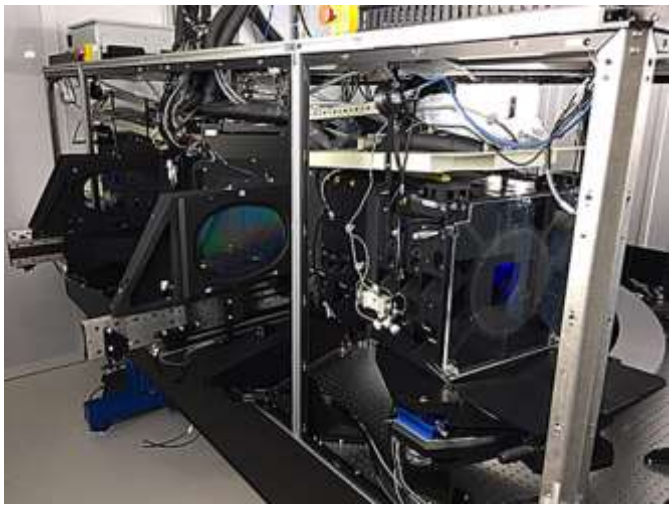


Image of M74 Galaxy obtained using PF-QHY on the WHT and R, G, B and Hα filters. Credit: Darío González Picos, Lara Monteagudo, Chris Benn and Ovidiu Vaduvescu.



The WEAVE spectrograph has already been installed at the WHT. It has two arms, each with its own custom-built cryostat – a liquid-nitrogen refrigeration unit which will cool the detectors to help limit background noise. Each cryostat houses a mosaic of two 6k × 6k CCD detectors, for a total of more than 150 megapixels to measure the spectra of stars and galaxies.

Thank you Mike

SPACE NEWS TO NOVEMBER 2021

Artemis 1 is Launching in February

It's been a long time coming, but NASA's next moon rocket is just months from liftoff on its first uncrewed test flight. The Space Launch System (SLS) is a super heavy-lift vehicle capable of delivering 95 tons to Low Earth Orbit, but its primary purpose will be to deliver humans to lunar orbit and, eventually, to the lunar surface. SLS has been in development since 2011, and it's faced a series of delays, but launch day is finally within sight. Earlier this month, the rocket was fully stacked for the first time in the Vehicle Assembly Building at the Kennedy Space Center, and the Orion capsule (the spacecraft's crew cabin) was attached to the top. The full stack stands an impressive 322 feet tall, just shy of the Saturn V's 363 feet.

NASA Administrator Bill Nelson (a former astronaut himself) told reporters that "with stacking and integration of NASA's Space Launch System rocket and Orion spacecraft complete, we're getting closer and closer to embarking on a new era of human deep space exploration… Thanks to the team's hard work designing, manufacturing, testing, and now completing assembly of NASA's new rocket and spacecraft, we're in the home stretch of preparations for the first launch on the Artemis I mission, paving the way to explore the Moon, Mars, and beyond for many years to come."

NASA announces that SLS is fully stacked on October 22, 2021.

With stacking complete, the next major task will be to roll the rocket out to the pad, where a full wet dress rehearsal will take place. The wet rehearsal involves loading propellant into the vehicle and performing a countdown, testing every aspect of the mission just shy of actually blasting off. The exact date for liftoff of Artemis 1 will be determined after the wet dress rehearsal ensures everything is in good working order.

Artemis 1 will spend over three weeks in space. While in orbit around the Moon, it will test out systems and perform experiments, including the Matroshka AstroRad Radiation Experiment (MARE), which will try out new technologies designed to protect human tissue from the dangerous radiation outside Earth's protective magnetosphere.

The mission will also carry 10 Cubesat with varying science and engineering goals. Some of the more interesting include Lunar IceCube, which will look for ice on the Moon with an infrared spectrometer, and NEA Scout, which will deploy a solar sail and navigate to a small nearby asteroid. A Japanese Cubesat called OMOTENASHI will impact the moon with a solid rocket booster, while ArgoMoon will maneuver around the SLS upper stage, taking high resolution images.

The February launch will be the first test of a rocket designed to carry humans to the moon since the days of Apollo (unless you count the canceled Constellation program, which tested its Ares 1 rocket back in 2009).

NASA's plans for Artemis 1.

If Artemis 1 is successful, the next flight of SLS will be the real deal, with astronauts on board. Artemis 2 will carry four people and has a tentative launch date of September 2023. Artemis 3 will follow, carry humans to the lunar surface itself. Artemis 3 currently has a 2024 launch date, but this is expected to slip. Future missions will construct a space station (the Lunar Gateway) in the vicinity of the Moon, and perform longer duration visits to the lunar South Pole, with the intended goal of building a more permanent presence on and around our nearest celestial neighbor. The Artemis Program will test various in-situ resource utilization techniques with the ultimate goal of learning how to operate in deep space for long durations, which will be necessary for an eventual human mission to Mars.

Early Earth was Pummelled 10x More Than Previously Estimated

It's no secret that Earth was bombarded with plenty of meteors for billions of years during the solar system's early formation. Estimates vary on how much material impacted the planet, but it had a considerable effect on the planet's atmosphere and the evolution of life. Now, a new study from a team led by researchers at the Southwest Research Institute puts the number at almost ten times the number of previously estimated impacts. That much of a difference could dramatically change how geologists and planetary scientists view the early Earth.

Early on, the solar system was much more populated with space rocks. Those space rocks were known to hit Earth, and speculation abounds about what happened when they did so. Earth eventually partially cleaned out its orbital path, culminating in the period called the Late Heavy Bombardment.

Not as many rocks hit the Earth in its later years, but the ones that did had a huge impact.

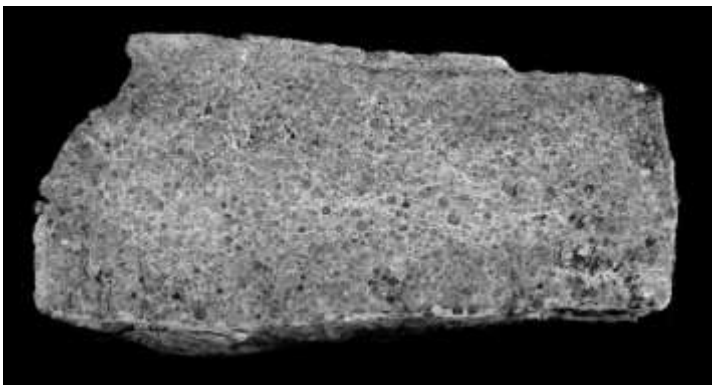
While the destructive power of that time period has been well documented, large asteroids continued to impact the Earth consistently for billions of years. When they did so, they formed "impact spherules" of molten rock that were thrown into the air, solidified, and then landed back on the Earth's surface. They became distinct sand-grain-sized spherical components of the geological layers laid down when their impact happened.

There are multiple spherule layers in the geologic record, showing that impacts large enough to create sky-bound ejecta were common. More have been found recently, leading researchers to examine whether the newfound abundance of these spherule layers was accounted for in simulations of early asteroid bombardment.

What was the Late Heavy Bombardment that pummelled Earth for millions of years?
Credit – History of the Earth YouTube Channel

It turns out they weren't – current bombardment models resulted in about ten times fewer spherule layers that have been found in the geological record. Consequently, that implies up to ten times more major asteroid impacts in that time period than models had predicted.

That many more impacts could have had a significant effect on one of the most important environmental factors of the early Earth – its oxygen level. After discovering the discrepancy between the model predictions and the geological data, researchers moved on to modeling what influence these impacts would have on the planet's environmental chemistry.



Cross-section of a spherule layer created by a major asteroid impact.
Credit – SwRI

Unsurprisingly, it had a pretty major impact. Large impacts, such as those creating spherule layers, can create reactive gases that react with oxygen to pull it out of the atmosphere. According to the geological record, for much of Earth's early history, it had extraordinarily low oxygen levels. It turns out that multiple large impactors might have maintained low levels for billions of years.

Those billions of years eventually ended with what is now known as the Great Oxidation Event, where atmospheric oxygen levels spiked dramatically. At that point, Earth had cleared out most of the larger asteroids in its vicinity, so the additional oxygen released into the atmosphere by its burgeoning biosphere wasn't wiped out by the reactive gases from asteroid impacts.

That event was one of the significant dramatic shifts in the history of life on Earth. Understanding it now, from so far in the future, is difficult. But it is helpful to know that it was partially enabled by Earth clearing out its orbital path and subjecting itself to significant punishment for billions of years. Just another example of how so many things had to go right for intelligent life to evolve.

Researchers Use Ancient Literature to Track 3,000 Years of Auroras

Auroral activity on Earth varies over time. As the magnetic poles drift, auroras can appear at different latitudes around the globe. Solar activity also affects them, with powerful solar storms pushing the auroras further into mid-latitudes.

In an effort to better understand how auroras move around, how they'll move in the future, and when powerful solar storms might pose a threat, a team of researchers have tracked auroral activity for the last 3,000 years.

A pair of researchers associated with the National Institute of Polar Research and other institutions in Japan have used ancient literature and modern data to map the shifting auroral zone over the last three millennia. By finding historical accounts from cultures around the world they've created a video covering three thousand years of auroral drift.

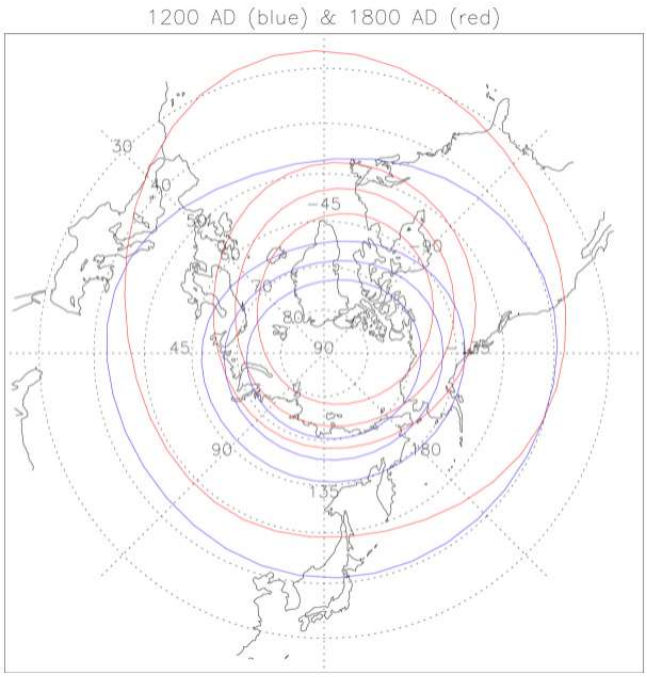
They've published their research in the Journal of Space Weather and Space Climate. The paper's title is "Auroral zone over the last 3000 years" and the first author is Ryuho Kataoka, associate professor at the National Institute of Polar Research.

Reconstructed auroral zone over the last 3000 years.

"The accurate knowledge of the auroral zone over the past 3,000 years — via worldwide old witness record of auroras, including those even from low-latitude Japan — helps us understand the extreme magnetic storms," said first author Kataoka in a press release.

Science played a role alongside ancient writings in this study. Paleomagnetism is the study of magnetic evidence in rocks, and the researchers used paleomagnetic models to map Earth's auroral zone over time. The auroral zone is an oval shape that shifts over time. Most auroras occur in a band about 20 to 30 degrees from the poles. But that zone can stretch further into middle latitudes when powerful solar storms take place; even over regions such as Japan.

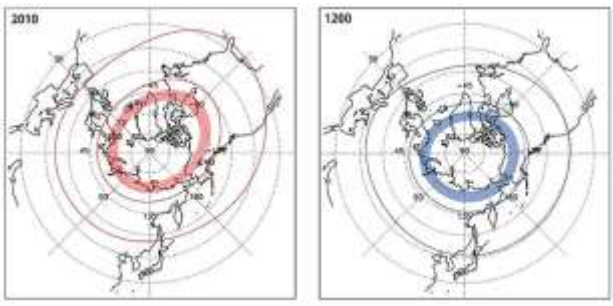
"The auroral zone changes over time, and the deformation and sporadic expansion of the auroral oval are recorded in historical documents over a thousand years from across the world," Kataoka said.



Estimated global shape of the auroral zone in 1200 AD (blue) and 1800 AD (red). Contours are apex field intensities of 49, 173, 474, and 6178 nT, corresponding to 70, 65, 60, and 40 magnetic latitudes. Japan's longitude (135 E) is toward the bottom. Image Credit: Kataoka and Nakano 2021.

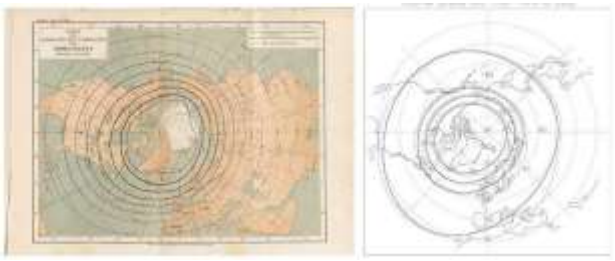
One of the historical documents the researchers made use of is an Old Norse text called "The King's Mirror." It's 70 chapters long and is written as a dialogue between father and son. In this case, the father is Haakon IV Haakonsson and the son is Magnus Haakonsson. The text was intended to instruct Magnus in royal affairs and prepare him for reign. It's mostly concerned with matters of the court, morality, chivalry, trade, and strategy and tactics. But The King's Mirror also contains descriptions of auroral activity over Greenland in 1200-1300 AD.

The pair of researchers also consulted a Japanese text called *Nippon Kisho-Shiryo*, which contains records of aurora and other phenomena. The *Nippon Kisho-Shiryo* has a cluster of auroras around 1200 AD, which matches what The King's Mirror shows. In fact, in the following century, paleomagnetic data shows that the auroral zone moved away from Japan and settled over Greenland. According to first author, the historical accounts match the paleomagnetic evidence.



Reconstructed auroral zone in 2010 AD (left) and 1200 AD (right). Image Credit: Kataoka and Nakano 2021.

Paleomagnetic data shows another auroral dip over the United Kingdom during the 18th century, which also matches up with written accounts.



Left: Auroral isochasm by Fritz (1881). The compiled documents were from 1700 to 1872 AD.
Right: Reconstructed auroral zone in 1800 AD (black) and possible deformation by a 170-year integration for the time interval between 1700 AD and 1870 AD (red).

One of the researchers' goals was to find out if witness accounts of auroras match up with paleomagnetic data. Specifically, they wanted to see if scientific data supported the idea that the 12th century was the best time in Japan to witness auroras. They were able to confirm that, and more.

"We concluded that the 12th and 18th centuries were excellent periods for Japan and the United Kingdom, respectively, to observe auroras in the last 3,000 years," Kataoka said in a press release.

The Radio Signal From Proxima Centauri Came From Earth After All

Turns out we were hearing ourselves! Earth can be a noisy place when listening to stars.

Late last year, a story was leaked indicating that the Murriyang radio telescope in Australia had detected a "signal-of-interest". Dubbed "blc1" (Breakthrough Listen Candidate 1), the signal appeared to originate from the direction of Proxima Centauri, the closest neighbouring star to the Sun. The signal had yet to be fully analyzed when the story was leaked. Now that the analysis is complete, research shows blc1 is in fact "RFI" – radio frequency interference – and not an interstellar signal.

But while it's not aliens – or "Proxima Centaurians" as lead author on the signal analysis Dr. Sofia Sheikh whimsically refers to them – new methodologies for conducting radio-based SETI (Search for Extraterrestrial Intelligence) have been developed by analyzing blc1; further honing our ability to distinguish future potential ET signals from our own planet.

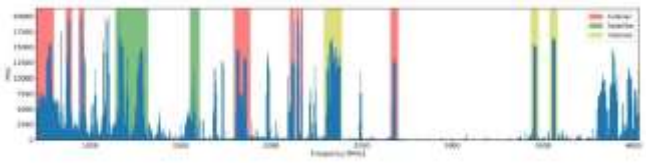
Simulation of Proxima Centauri b , Rocky World in the Proxima Centauri System – SpaceEngine by author

A Needle in a Hay Stack

BLC1 – Breakthrough Listen's First "Signal of Interest" – with Dr. Sofia Sheikh

From April 29th to May 4th of 2019, the Murriyang telescope targeted ProxCen (Proxima Centauri) to monitor solar flare activity. ProxCen is a red dwarf star located 4.2 light years from Earth. Red dwarfs, are known for their massive solar flares but given that they dominate the stellar population of our galaxy, we want to know how these flares may affect the ability of red dwarfs to harbour life. Mega flares could tear the atmosphere off a planet! ProxCen has demonstrated mega flare activity but also contains at least one rocky planet in the star's "habitable zone" where it's warm enough to allow for liquid water.

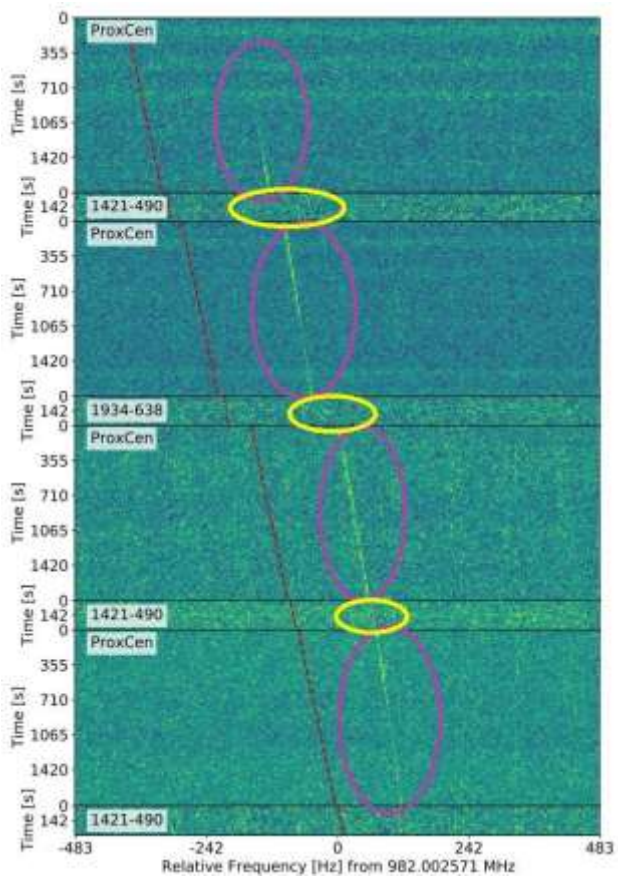
Murriyang's scan of ProxCen is intense – 800 *million* radio frequencies monitored simultaneously spanning the 700Mhz to 4Ghz range. 20TB of information is collected in a matter of days. In addition to flares, Berkeley undergraduate student Shane Smith working with Breakthrough Listen, currently the world's largest SETI project, used software called turboSETI to scan for signs of alien technology. The software filters signals with certain patterns that may indicate something of interest. After filtering 4 MILLION detection "hits", *one* very peculiar signal remained warranting further scrutiny.



Narrowband (technological) signal hits detected in range of the Muriyang telescope. Noted are the registered cellular, satellite, and broadband internet transmitters which can be ruled out immediately as Earth-based signals. c. Smith et al 2021 Figure 2

Smith, found a signal at 982.002571 Mhz, – possibly the SETI winning numbers. Why did this one stand out from the millions of others? Some can be removed straight away as Earth-based signals such as cell-phones and internet transmissions at known frequencies. Another tell is whether the signal still appears when the telescope is pointed "off-source". At a regular cadence, the scope was pointed away from ProxCen to other calibration sources. If the signal remains when the telescope is moved away from the target, the source of the signal is more likely from Earth and not from the target.

The signals are then checked for "drift." Drift is the change in a signal's frequency over time. The hope is that this change in frequency is caused by the source of the signal moving relative to Earth – for example because it is orbiting around a distant star. Its motion creates a Doppler effect similar to the change in pitch of a passing ambulance. After all this filtering. One signal remained – a signal also so narrow in frequency, it couldn't be created by any known natural phenomenon. A candidate! Blc1! **Cue X-Files whistle.**



A “Waterfall Plot” that shows the presence of blc1. The vertical access is the detection over time from top to bottom. Circled in purple is the detected signal. Circled in yellow are the gaps where the telescope was off-source and pointed to calibration sources. The slope of the signal line is the signal’s drift over time which could indicate a signal source in relative motion to Earth. c. Smith et al 2021 Figure 4

Who Said That?

“For me, it’s the enormity of the challenge that draws me to SETI as a research field. In addition, because there’s so much research still to do in SETI, it allows me to be creative in my work and juggle multiple projects at a time, which I really enjoy!”

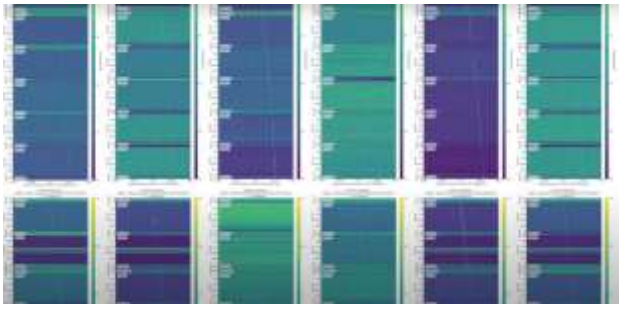
-Dr. Sofia Sheikh

But is blc1 Proxima Centaurians!? Dr. Sofia Sheikh, lead writer on the recently published signal analysis, wanted to find out.

As a unique discovery, blc1 required new methodology for testing which was developed by Sheikh and her team. The first tests rule out the most local of possibilities – the Murriyang facility itself. Diagnostics of the telescope on the days of recording were analyzed. The team also verified the scope didn’t simply detect local RFI from the surrounding complex. For example, was blc1 seen only when the telescope dish was pointed at a building coinciding with ProxCen’s direction? Reobservations of ProxCen were also made which yielded no signal.

Deeper analysis sought to explain blc1’s drift rate. The signal could still be from Earth but in motion relative to the telescope- originating from a car, airplane, or satellite. However, none of these possibilities accounted for the measured drift over the duration the signal was detected. Deep space objects like probes were not in the direction of ProxCen during the detections. But neither did the drift match what would be expected if the signal were moving relative to Earth within the ProxCen system itself.

So what else could cause the drift if not a moving object? Drift can also be created by an electronic device *designed to change frequency* like tuning a knob on a dial. To the telescope, such a device may appear to be moving even while fixed to the Earth’s surface.



A sampling of the RFI set that blc1 ultimately belongs too. The drift slope shape is similar across all these signals that appeared on-source as well as off-source indicating they are all part of a set of RFI likely belonging to a single source or created by the interference of various sources. c. Sheikh et al 2021

As a final step in the analysis, the team revisited the data to see if other signals similar to blc1 could be found. 60 signals, across a range of frequencies and all with incredibly similar drift to blc1, were discovered in the data. Each signal appeared to the telescope at the same time as blc1. Why were these signals initially filtered out? Because they appeared off-target and so were determined to be RFI. Blc1’s similarity to these other signals indicates it is most likely one of a set of signals that are all RFI. And, as a result of the way these signals mixed and interacted, blc1 appeared localized in space toward ProxCen even though it wasn’t. Furthermore, the spacing in frequency between the signals is in multiples of 2Mhz, a common spacing created by known Earth-technology – a clock oscillator. So, because blc1 so closely matches this set of signals, and the set can be identified as RFI, blc1 itself can also be ruled out as RFI. No calls from ET…(yet).

Listening to the Future

“As Freeman Dyson once said “Every search for alien civilizations should be planned to give interesting results even when no aliens are discovered.” Our “interesting results” are often cutting-edge astronomy in their own right!”

-Dr. Sofia Sheikh

The actual source of blc1, and its companion set of RFI, has yet to be determined. While not aliens, working to verify the signal helps us better detect aliens in the future. No signal has ever been ruled out as RFI by comparing it to other RFI before. That’s because no signal like blc1 had ever been seen before! This whole process was the result of the most sensitive search of ET radio signals ever conducted on a single target star. The results also demonstrate that software tools like turboSETI were doing their job. The software detected that 1 in 4 million signal that MIGHT be extraterrestrial triggering the flurry of analysis.

Two Confirmed Planets at Proxima Centauri – Video by Fraser Cain of Universe Today

Breakthrough Listen is expanding operation to include MeerKAT, a telescope array in South Africa that can observe targets with Murriyang simultaneously. The advantage of simultaneous observation is that a true interstellar signal will show up in *both* telescopes while RFI

would be unique to *one* – a technique used by some past SETI initiatives such as Project Phoenix.

Ultimately, a civilization or other life on Proxima b could still be possible. Given the system's proximity to Earth, it remains a target of interest for future observation. We could also just *GO* to Proxima Centauri to find out! Another component of the Breakthrough initiative is Breakthrough Starshot, a future mission to send a miniature probe all the way to our neighbouring star. Attach that probe to a massive solar sail accelerated by a few gigawatts of laser power and you have a craft headed to ProxCen at 20% the speed of light – thousands of times faster than our current probes. It would arrive in just 20 years – interstellar flight within a human lifetime!

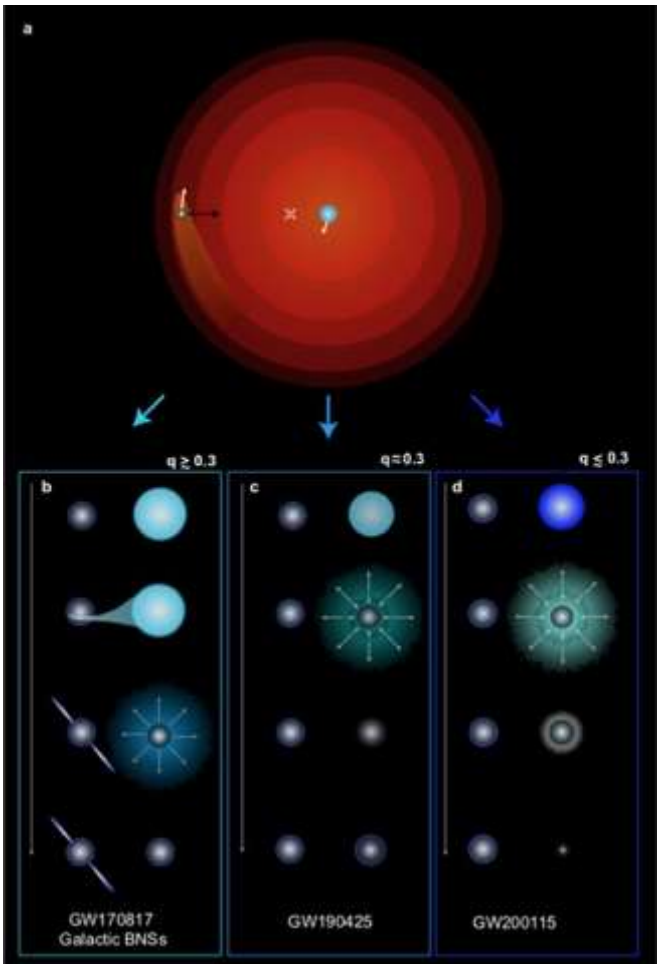
Until then, we keep listening to the stars.

"It would be very, very cool if life, technology, and even intelligence were features of our galaxy more broadly, and not just confined to our "pale blue dot" of Earth. But we'll just have to see what the data holds in the future!"

– Dr. Sofia Sheikh

Feature Image: The three telescopes at CSIRO's Murriyang Observatory. The primary dish is 64 meters wide and one of the largest moving dishes in the world. Credit: Red Empire Media/CSIRO.

Gravitational Waves Reveal Surprising Secrets About Neutron Stars



The confirmation of gravitational waves back in 2017 continues to unlock whole new worlds of physics but also continues to elicit further questions. The detection of each gravitational wave brings a new challenge – how to find out what caused the event. Sometimes that is harder than it sounds. Now a team led by Alejandro Vigna-Gomez of the University of Copenhagen thinks they found a model of star death that helps to explain some previously inexplicable findings – and points to a galaxy with many more massive neutron stars than previously thought.

In science, it is common to collect data that doesn't seem to fit the current scientific theory. That sort of unexpected data came from the Laser Interferometer Gravitational-Wave Observatory's (LIGO) second-ever gravitational wave finding. Usually, LIGO would record gravitational waves resulting from the collision of two massively dense objects, such as a black hole and a neutron star. In the case of its second positive recording, initially recorded in 2019 and now known as GW190425, the data pointed to the source as being two merging neutron stars, but they were surprisingly big.

UT video discussing what gravitational waves are.

Average neutron stars are tough to "see" in the traditional sense. Like their closely related cousin, the black hole, they usually form only after a supermassive star has imploded. However, occasionally they form pulsars, creating a form of star that is one of the most visible in the universe. Typically, the only way to see a binary neutron star system, such as the one that created the GW190425 gravitational wave signal, is if one of the two stars in the system is a pulsar and then interacts with its regular neutron star neighbor. But none of the known binary neutron star systems had heavy enough stars to match the signal seen by LIGO.

They lacked such stars partially due to larger stars turning into black holes rather than neutron stars when they die. However, the gravitational signals were coming from merging giant neutron stars, not merging black holes. So what is causing the formation of these large neutron stars, and why aren't they showing up in binary pairs with pulsars?

UT video on how to use gravitational waves to do astronomy.

According to Dr. Vigna-Gomez, the answer might lie in a type of star called a "stripped star." Also called a helium star, these stellar objects only form in binary systems and have their hydrogen outer shell forced away by the other star in the system, leaving a core of pure helium. The team modeled these types of stars to understand what happens to them after a supernova. It depends on two factors: the weight of the core that's left and the forcefulness of its supernova explosion.

Using stellar evolution models, the team showed that for helium stars, some of the outer layers of helium can be blown off in the explosion, lowering the weight of the star to the point where it is no longer able to become a black hole. That could potentially explain where the heavy neutron stars come from, but why aren't they more noticeable in binary systems with pulsars?

More details about neutron star collisions in this UT video

The answer comes from a standard process in binary systems – mass transfer. Often, one star in a binary system loses some of its material to the other, more massive, star in a process known as mass transfer. In neutron star systems, this mass transfer can sometimes spin up a neutron star into a pulsar. However, the larger the star's helium core, the less likely that mass transfer process is. So in systems that form massive neutron stars, it is less likely they would end up in a binary system with a pulsar. They are more able to hold on to their mass rather than transferring it to their binary companion, letting it light up as a pulsar.

Other data from LIGO back up this theory. It appears that heavy neutron star mergers are just as common in the universe as mergers of slightly less heavy neutron stars with pulsars. An entire population of large neutron star binary systems might exist, invisible to our usual detection methods. But now, with LIGO, we should at least be able to see when they merge, and that is another step towards truly understanding them.

Volcanism on the Moon Ended About 2 Billion Years ago

According to the most widely accepted theories, the Moon formed about 4.5 billion years ago after a Mars-sized object (Theia) collided with Earth. After the resulting debris accreted to create the Earth-Moon system, the Moon spent many eons cooling down. This meant that a few billion years ago, lakes of lava were flowing across the surface of the Moon, which eventually hardened to form the vast dark patches (lunar maria) that are still there today.

Thanks to the samples of lunar rock brought back to Earth by China's *Chang'e 5* mission, scientists are learning more about how the Moon formed and evolved. According to a recent study led by the Chinese Academy of Geological Sciences (CGAS), an international team examined these samples to investigate when volcanism on the Moon ended. Their results are not only filling in the gaps of the Moon's geological history but also of other bodies in the Solar System.

The study, which recently appeared in the journal *Science*, was led by Xiaochao Che of the Beijing Sensitive High-Resolution Ion Micro Probe Center, located at the CGAS Institute of Geography. He was joined by researchers from the Planetary Science Institute (PSI), McDonnell Center for the Space Sciences, the Swedish Museum of Natural History, Shandong Institute of Geological Sciences, and several universities from the US, UK, and Australia.

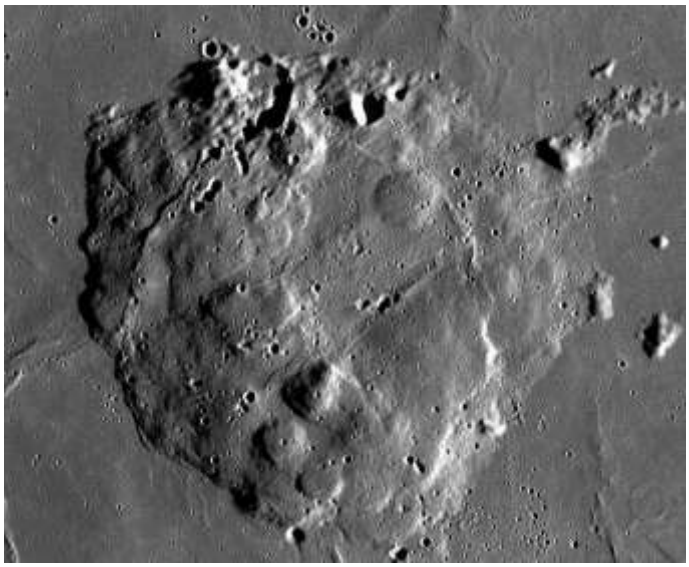
Mons Rümker is visible in Oceanus Procellarum in this image taken from the Apollo 15 mission in lunar orbit. Credit: NASA

The samples obtained by the *Chang'e-5* rover are the first to be returned to Earth since the Apollo era (45 years ago) and were obtained from the volcanic plain known as Oceanus Procellarum (Latin for "Ocean of Storms"). This lunar region is unique among lunar terrae, as it is believed to have hosted the most recent basalt lava flows on the Moon. Jim Head, a research professor in Brown's Department of Earth, Environmental and Planetary Sciences, was a co-author on the new study.

The Chang'e-5 spacecraft landed in this region on Dec. 1st, 2020, and managed to collect about 1,730 g (61.1 oz) of lunar rock from this region, including a core sample obtained from a depth of ~1 m (3.3 ft) beneath the surface. As he explained in a recent *News from Brown* press release:

"These samples come from a region of the Moon that's been largely unexplored by landed spacecraft. Previous samples from the Apollo missions and the Soviet Luna missions all come from the central and eastern part of the Moon's near side.

"But it became clear as we collected more remote sensing data that the most recent volcanism on the Moon was absolutely in that western portion, so that region became a prime target for sample collection. Specifically, the samples came from near Mons Rümker, a volcanic mound in the largest of the lunar maria, Oceanus Procellarum."



Mons Rümker, a volcanic construct in Oceanus Procellarum on the Moon. Mosaic of photos by Lunar Reconnaissance Orbiter, made with Wide Angle Camera. Credit: NASA

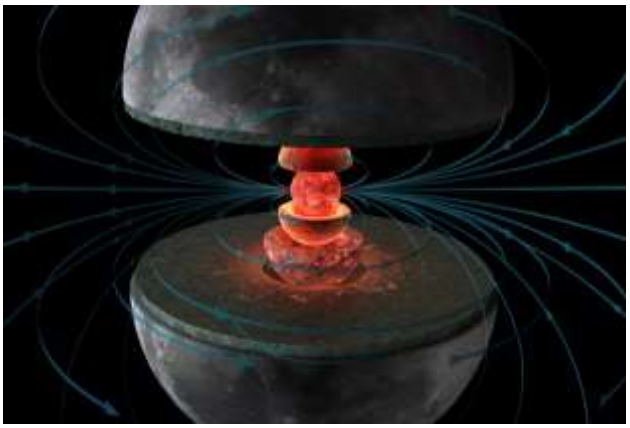
The Oceanus Procellarum region is characterized by high concentrations of radioactive elements such as potassium, uranium, and particularly thorium. These generate heat through long-lived radioactive decay and are believed to have played a role in prolonging magmatic activity on the near side of the Moon. After examining the samples through radiometric dating, the team concluded that they were (on average) 2 billion years old.

"However, in these samples, we didn't actually see an elevated radioactive element composition," said Head. "If these radioactive elements are driving the volcanism in this region, we expect to see enhanced radioactivity in the samples. But we didn't. Instead, the composition was similar to mare basalts from older deposits. So that casts some doubt on that hypothesis for long-lasting volcanism."

Essentially, their examination revealed that alternative explanations are needed for why the Oceanus Procellarum region experienced a prolonged period of lunar magmatism. However, the most significant takeaway from this study is how it managed to constrain the age of some of the most recent basaltic lava samples from the Moon. This not only establishes an endpoint for the Moon's most active volcanic period but is critical to modeling its thermal evolution and geological history as well.

And as Head indicated, it also serves as a means for calibrating the timing of other events in the Moon's geological history and on other bodies in the Solar System:

"When we look at a surface or a feature on the Moon from which we don't have samples for radiometric dating, we try to estimate its age through the size-frequency distribution of impact craters. Basically, as time goes by, larger impacts become more rare. So by counting craters of different sizes, we can establish a relative age of a surface.



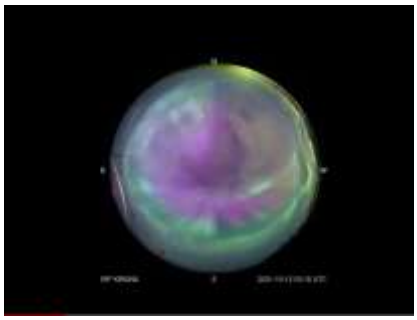
Understanding the Moon's geological history will help to reconstruct the history of our Solar System. Credit: Hernán Cañellas/Benjamin Weiss

Last but not least, these examinations allow scientists to fill critical gaps in our understanding of the Moon's history. "But between about one billion and three billion years ago, we don't have many good data points to tell us what the impact flux looks like," Head added. "So having an absolute radiometric date for this surface helps us to calibrate the flux curve, which helps us to date other surfaces. And that's not true only for the Moon. This helps us calibrate ages for Mars, Venus, and elsewhere."

The samples obtained by the *Chang'e-5* rover are also the first to be returned to Earth since the Apollo era (45 years ago). You might say that the results of this research are a preview of how our renewed lunar exploration efforts will yield new and valuable insights into how the Earth-Moon system formed and evolved. These, in turn, could shed light on how habitable conditions emerged and lasted on Earth but no other bodies in the Solar System.

Further Reading: Brown University, Science

Here's the View From Sweden During the Recent Solar Storm



Vivid green and purple aurora swirled and danced across the entire night sky in Sweden recently. The nighttime light show was captured by an all-sky camera in Kiruna, Sweden, which is part of the European Space Agency's (ESA) Space Weather Service Network.

This camera is pointed straight up, and is fitted with a fish-eye lens to be able to capture the sky from horizon to horizon. The Aurora Borealis, also known as the Northern Lights, were visible due to the impact of a coronal mass ejection (CME) into our planet's magnetosphere on October 12. A solar storm on the Sun ejected a ejected a violent mass of fast-moving plasma into space on October 9, 2021. A few days later, aurora were seen around the world in the northern hemisphere.

"What I love about this video is the chance to see this beautiful, purple aurora, more clearly visible during intense geomagnetic storms," said Hannah Laurens, a Space Weather Applications Scientist based at European Space Operations Center (ESOC). "The movement of this swirly structure in space and time is often referred to as auroral dynamics."

Laurens explained how the aurora is a manifestation of complex drivers operating in the distant magnetosphere which makes it a useful, and beautiful, tool with which to monitor space weather conditions. But being able to study the auroral dynamics is especially important when studying the relationship between the ionosphere and magnetosphere, which are linked by lines of magnetic field.

Various spacecraft keep an eye on the Sun: the Solar Dynamics Observatory, the Parker Solar Probe and Solar Orbiter are just some of the tools scientists use to learn more about our star and how it affects our planet. Observatories on the ground, like all-sky cameras, are also vital to understanding the complex, and sometimes hazardous interactions between the Sun and Earth.

All-sky cameras have operated in Kiruna since the International Geophysical Year 1957-1958, and a digital all-sky camera has been in operation since 2001. The Kiruna Atmospheric and Geophysical Observatory (KAGO) is part of the Swedish Institute of Space Physics (IRF),

While most of the solar wind is blocked by Earth's protective magnetosphere, some charged particles become trapped in Earth's magnetic field and flow down to the geomagnetic poles, colliding with the upper atmosphere to create the beautiful aurora.

(So like my views from Iceland in 2019 Andy)

William Shatner Completes his Trip to Space With Blue Origin

After traveling to the edge of space this week, William Shatner and the crew of the NS-18 mission made it back to Earth safe and sound. This was the second time Blue Origin's *New Shepard* launch vehicle flew to space with a crew aboard, and as with the inaugural flight, Blue Origin founder Jeff Bezos decided to enlist some star power! Who better than the man known to millions of fans as James Tiberius Kirk, Captain of the starship Enterprise?

At 90 years of age, the veteran actor of television, film, and stage is the oldest person to fly to space. The previous record was held by 82-year old veteran aviator Wally Funk, who went to space as part of the first crewed flight of the New Shepard on July 20th. Along with his fellow crewmembers, Shatner's experienced what it's like to go to space for the first time from the company's Launch Site One facility in West Texas.

On Wednesday, Oct. 13th, the flight took place at 09:49 AM local time (10:49 AM EST; 07:49 AM PST) and saw the *RSS First Step* space capsule ascend beyond the Kármán Line – the official boundary of space, 100 km (62 mi) in altitude. And of course, the entire experience was caught on film, particularly the five minutes where the crew of four were weightless and looked out at Earth's horizon from space.

Shatner expressed what it was like to be selected for the NS-18 mission in a video released by Blue Origin prior to launch (shown above). "Having played the role of Captain Kirk, everybody assigns me the knowledge that a futuristic astronaut would have," he said. "But I've always been consumed with curiosity, and it's the adventure that I feel so good doing."

Upon landing, Shatner had some teary words to share with Bezos, and all those turned out at the landing site to greet them. "Everybody in the world needs to see. There is mother Earth and comfort. But what you see is black. What you have given me is the most profound experience I can imagine. I'm so filled with emotion with what just happened. It's extraordinary. Extraordinary."

In addition to Shatner, the crew included Audrey Powers, the vice president of mission and flight operations at Blue Origin and the chair of the Commercial Space-flight Federation's board of directors. "I think I reached a certain age, and I had given up on the idea that I would go to space," she said. "I was teary-eyed that this opportunity has befallen me. It's one of those moments where your life flashes before your eyes, you know?"

Rounding out the four-person crew were Chris Boshuizen and Glen de Vries, who were paying customers. Boshuizen is an Australian investment banker with DCVC and the co-founder of Planet, an Earth-observation and satellite data provider. De Vries, meanwhile, is the co-founder of Medidata Solutions (a clinical research company) and the vice-chair of life sciences and healthcare at the French software company Dassault Systèmes.

Blue Origin CEO Bob Smith praised the mission and its participants in a company press release that followed the completion of the successful flight:

"At Blue Origin, we are motivated by the dreamers that inspire us and the builders who turn those dreams into reality. Today's crew represented both dreamers and builders. We had the honor of flying our very own Audrey Powers, Vice President of New Shepard Operations, who fulfilled a lifelong dream to go to space and has been an integral part of building New Shepard.

"Our two customers, Chris Boshuizen and Glen de Vries, have built their own successful ventures and have now realized their own dreams of space travel. And, as everyone knows, William Shatner has played an important role in describing and imagining the wonders of [the] Universe and inspired many of us to pursue a career in the space industry. This flight was another step forward in flying astronauts safely and often. It's an incredible team and we are just getting started."

All told, the NS-18 flight lasted a total of 10 minutes and 17 seconds, achieved a maximum altitude of 107 km (mi) and a max ascent velocity of 3,597 km/h (2,235 mph). The mission also represented several milestones for the company, which included being the 17th consecutive booster landing and the fourth consecutive landing for this particular booster. It was also the 19th consecutive successful landing with a *New Shepard* crew capsule.

"Congratulations to the entire Blue Origin team on today's mission and stay tuned for more from Launch Site One!" tweeted Jeff Bezos from Blue Origin's official Twitter account.

Perseverance has Collected its First Sample of Mars and Prepared it for Return to Earth… Eventually

It's another first for NASA.

In early September, the Perseverance rover successfully used its robotic arm and drill to drill into a rock and extract a sample. It extracted a rock core about 6 cm (2 in) long and placed it inside a sealed tube. This is the first time a robotic spacecraft has collected a sample from another planet destined for a return to Earth on a separate spacecraft.

Now we wait for the eventual return of the sample to Earth.

Missions to Mars keep getting more and more complex. It's been about 45 years since Viking 1, the first lander on Mars, made it to the surface of the planet. It sat there at Chryse Planitia for over six years, taking soil samples and searching for signs of life. Almost all scientists agree that it didn't find any signs of life (some still think that Viking 1's labelled release experiment showed signs of life.) But it did characterize the Martian soil and atmosphere. It also found striking evidence of liquid water flowing over the planet's surface in the ancient past.

Look at how far Mars exploration has come since then.

This infographic shows the location of every successful mission that has landed on Mars. Image Credit: *The Planetary Society*

The Perseverance mission is a triumph of complex engineering, technology, and mission design. It was built on the shoulders of previous successful NASA rover missions to Mars, especially MSL Curiosity. But it's more ambitious than even its most recent predecessors because it's collecting samples and caching them on the surface for eventual return to Earth.

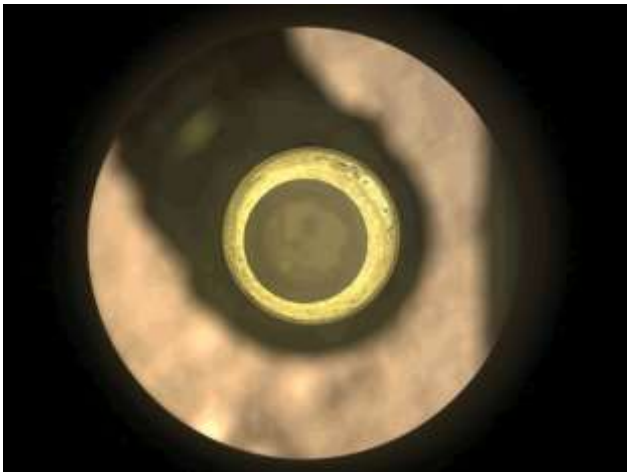
Altogether, Perseverance is carrying 43 sample tubes. 38 of them are designated for samples, and the other five are witness tubes. The witness tubes were filled with materials prior to launch and are used to capture molecular and particulate contaminants at sampling sites. They're designed to "… catalogue any impurities that may have travelled with the tube from Earth or contaminants from the spacecraft that may be present during sample collection," according to NASA. Each of the rest of the 38 sample tubes can carry a sample of a solid or a sample of a gas.

Martian rock is ancient rock. The planet isn't geologically active, so it doesn't make any new rock. Its volcanoes are all inactive, and there is no plate tectonics. Jezero Crater, where Perseverance is working, is in the Isidis Planitia impact basin. The rocks there date back to Mars' Noachian period, which spans from about 4.1 billion to 3.7 billion years ago. Rocks from that time period are prime targets in the search for life because Mars was much different then.

The atmosphere was thicker, and the climate was warmer. There may even have been rainfall. The rover's first sample is from the "South Séítah" region of Mars' Jezero Crater, and according to NASA it may contain some of the deepest, and potentially oldest, rocks in the giant crater. If there is fossilized evidence of ancient microbial life on Mars, it could very well be in the rocks that Perseverance is sampling at South Séítah.

NASA's Mars Perseverance rover acquired this image using its onboard Right Navigation Camera (Navcam). The camera is located high on the rover's mast and aids in driving. This image was acquired on Aug. 27, 2021 (Sol 185). Credits: NASA/JPL-Caltech.

Getting samples from Mars back to Earth is a huge deal to geologists. Earthly laboratories are far better equipped than the Perseverance rover when it comes to studying samples. And we'll keep developing better, cutting-edge technologies while the Perseverance rover continues on its mission. By the time the samples ever get to Earth, technology will have advanced even further. Who knows what exactly we'll learn from the Martian samples?



Perseverance's first Mars rock sample inside its tube, seen here prior to sealing. Image Credit: NASA/JPL-Caltech

It'll be several years before the samples ever land on Earth. The sample-return mission is still being designed, and Perseverance will be collecting samples for years.

But getting the precious samples back to Earth is not a done deal. The separate mission to retrieve the samples and bring them to Earth is extremely complex. It involves multiple spacecraft and multiple space agencies. And at this point, it's only a proposed mission.

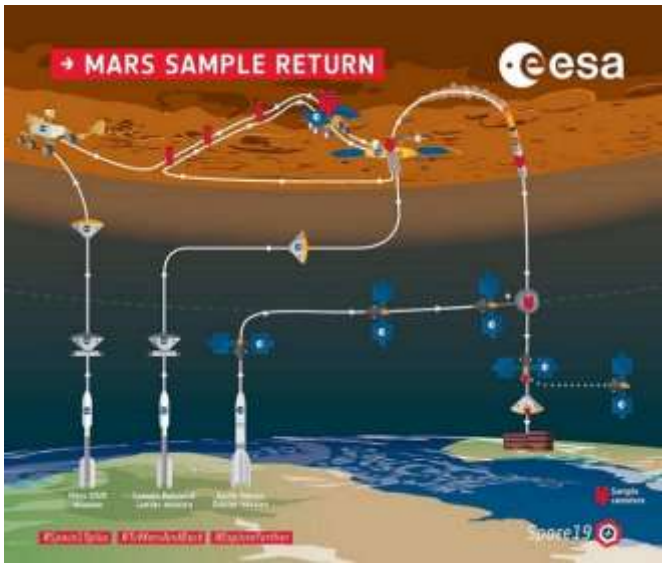
"I have dreamed of having Mars samples to analyze since I was a graduate student."

Meenakshi Wadhwa, principal scientist, Mars Sample Return program.

The ESA and NASA are working together on the sample return mission. Many details are yet to be worked out, but the agencies have agreed on the overall architecture. In July 2026 a spacecraft would be launched to Mars that consisted of a lander, a rover, and an ascent rocket. Once on the surface in 2028, the lander would deploy the sample gathering rover to collect the samples. If Perseverance is still operating at that time, it could retrieve samples too.

Once the samples are all gathered, they'll be placed inside a sample return capsule in the ascent rocket. An additional spacecraft, designed and built by the ESA and called the Earth-return orbiter, will be launched from Earth in 2026. It'll enter a low Martian orbit by July 2028. Then, the ascent rocket carrying the sample return capsule will be launched into orbit, too.

The rocket and the Earth-return orbiter will rendezvous in low Mars orbit, and a robotic arm on the return orbiter will take the sample return capsule from the rocket. The samples will be placed in an Earth return capsule and returned to Earth during the 2031 Mars-Earth transfer window.



An infographic showing the elements in the Mars Sample Return program. Credit: ESA

A lot has to go right for all of this to work. Getting all the spacecraft launched and landed safely is a challenge in itself. So is the rendezvous between the ascent rocket and the orbiter. But there are a whole host of other obstacles that may not be obvious.

One of the obstacles involves extreme temperatures. The return capsule has to be sealed and sterilized to protect the samples from contamination. The team designing the system is looking at brazing the capsule shut. Brazing uses heat to join pieces of metal together, and the heat also sterilizes everything. But, the samples themselves have to be protected from extreme heat. The idea is to never subject the samples to temperatures higher than they were subjected to on Mars, for obvious reasons.

"Among our biggest technical challenges right now is that inches away from metal that's melting at about 1,000 degrees Fahrenheit (or 538 degrees Celsius) we have to keep these extraordinary Mars samples below the hottest temperature they might have experienced on Mars, which is about 86 degrees Fahrenheit (30 degrees Celsius)," said Brendan Feehan, the Goddard systems engineer for the system that will capture, contain, and deliver the samples to Earth aboard ESA's orbiter. "Initial results from the testing of our brazing solution have affirmed that we're on the right path."

Scientists like Meenakshi Wadhwa, who is the principal scientist for the Mars Sample Return program, are very excited to get these ancient samples into labs here on Earth. In a press release, Wadhwa said, "I have dreamed of having Mars samples to analyze since I was a graduate student. The collection of these well-documented samples will eventually allow us to analyze them in the best laboratories here on Earth once they are returned."

Once on Earth, the samples will likely be analyzed and reanalyzed for decades to come. That's what's happened with lunar rocks brought back from the Moon in the Apollo missions. As we keep developing new technological tools to study them with, scientists keep learning more and more from them.

The same will be true of these Martian samples. If the sample return mission succeeds.

E Mails Viewings Logs and Images from Members.

Viewing Log for 10th of October

During late afternoon/early evening I had been playing golf in brilliant sunny weather. After having a beer at the 19th hole, I went home had some tea and decided I would go out and do my first viewing session since 6th of May. I believe this has been my longest gap (over five months) between viewing sessions?

On my way to my usual viewing place near Uffcott off of the A4361 I noticed a waxing crescent moon setting on the horizon, so I knew I would not have any problems from the moon this evening? By 20:43 I had my Meade LX90 GOTO telescope set up and ready for use, I would be using a Pentax 14mm XW eye piece. With a temperature of 12° and no wind it should be a reasonable session, I did have my winter jacket on but was wearing jeans and trainers which would normally not keep any cold weather out for very long? First target was Saturn with the moon Titan nearby but this was currently in some leaves in the only tree to the south of me, would have to come back to this planet later in the session! So on to Jupiter, the four main moons were two either side of the planet and the SEB was brighter of the two, could not make out GRS even using a 38A or 58A filter? Turns out check Jupiter 2 software later on the GRS was still on the other side but would be around within the hour? Both Saturn and Jupiter were in the view of the eye piece yet neither Neptune nor Uranus were. I have been having trouble with both of these planets, not being where the hand controller thought they should be? So with the planets out of the way I thought I would have a bash at some Messier (M) objects, first was M 10 a faint blob (F B) globular cluster (G C), did not help being very low near the horizon. If I had been here a bit earlier it would probably have been better to look at? Anyway on to M12, this G C fared even worse than M 10. So gaining a bit of altitude I had a look at M 14 which is also in Ophiuchus, this G C was also an F B to look at but was a bit brighter, maybe there was some thin cloud in this part of the sky which I could not see? Staying with G C's I thought I could not go wrong with M 13 in Hercules, this turned out to be big and bright, could even make out the odd star within this cluster. Also in Hercules is M 92 which often gets over looked by M 13 fans, this G C was a bit smaller but had a bright core. Onto Lyra and M 56, this G C was small but also had a bright core. Time to look at the odd planetary nebula (P N) starting with M 57, the 'Ring Nebula', this was good to look at, M 27 the 'Dumbbell Nebula' was a large grey blob to look at. Not far away is M 71 in Sagitta, a small and dim G C to view. Now onto some open clusters (O C) and M 29 in Cygnus, this object looks like a slightly crushed rectangle, middle two stars a bit closer together than the others that make up this O C? M 39, also in Cygnus was loose to look at. Looking at my Sky & Telescope pocket sky atlas I noticed the 'Blinking Planetary Nebula', aka NGC 6826. When I went to this object, all I could make out was a small star and nothing else, this is aka Caldwell (C) 15. Next was NGC 6885, a large and very loose O C which turned out to be C 37. Final NGC object for the evening was 6882, says it is an O C but I could not make anything out! By now I had the second and final car go past me for the evening (Sunday's are by far the best evening to view for lack of cars going past me?). By now Saturn had cleared the tree, so I went back to this planet, could not make out the Cassini division but the rings were very clear. Next was NGC 457 better known as the Owl cluster or C 13, a very good O C to look at? Also in Cassiopeia is M 103 a tight O C to look at? When I arrived at my viewing place I thought I noticed M 45 above the eastern horizon but took no notice of it as I thought it should still be below the horizon? How wrong I was, some winter objects were above the horizon with more not far off! It is best to look at this large O C with the finder scope as the main scope you look thru the object. Thought I could see the star Fomalhaut close to the southern horizon, slewing to it I noticed it was at a declination of -29 ° 37 '. This is the lowest mag 1 star viewable from the UK? Final object for the evening, could I find Uranus or not? Slewing back to where the hand controller thought it was, I viewed thru the finder scope and tried various stars and finally found the planet about a quarter of the way from the middle of the finder scope. Strange how I can have some planets on view yet others I have to go hunting for?

By now it was 22:32 and time to pack up. There was very little dew on the equipment but would still need to be dried off once I got home. Finishing temperature was 9 °, just nice to get out there and do some viewing after such a long layoff. Playing golf and doing astronomy in the same day, a good day for me!

Clear skies.

Peter Chappell

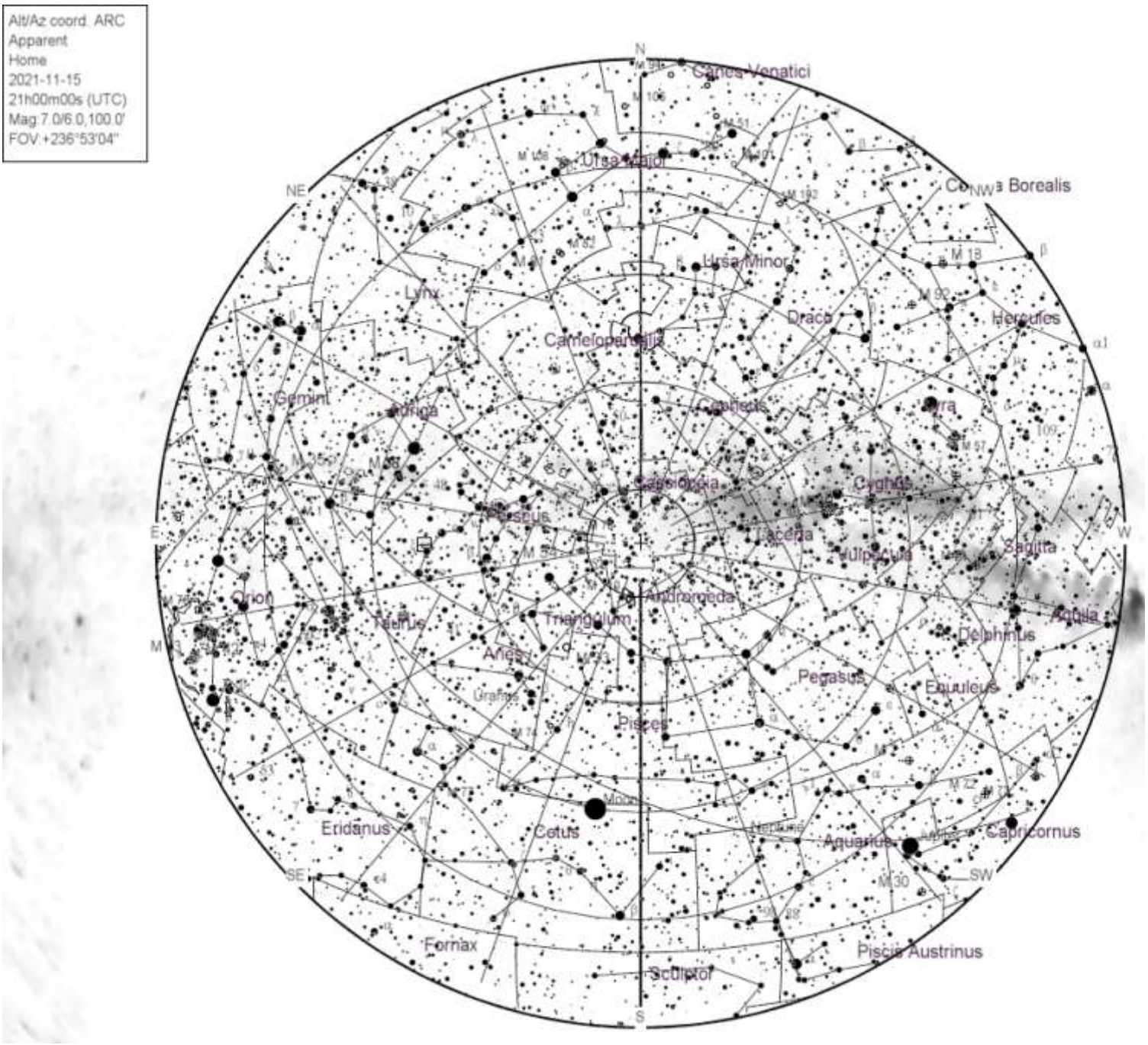
Some pictures from home on the 7th October following the last meeting. Andy.

D810 on 125 Evostar Pro telescope, from the middle of Chippenham. 60 second exposures, single frame.

Messier 33 galaxy

NGC281 Pacman nebular, with filter LP Enhance 120seconds.

WHATS UP, NOVEMBER 2021



.**November 4** - **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 21:15 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.

November 4, 5 - **Taurids Meteor Shower.** The Taurids is a long-running minor meteor shower producing only about 5-10 meteors per hour. It is unusual in that it consists of two separate streams. The first is produced by dust grains left behind by Asteroid 2004 TG10. The second stream is produced by debris left behind by Comet 2P Encke. The shower runs annually from September 7 to December 10. It peaks this year on the the night of November 4. The new moon will leave dark skies this year for what should be an excellent show. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Taurus, but can appear anywhere in the sky.

November 5 - **Uranus at Opposition.** The blue-green 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 Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

November 17, 18 - **Leonids Meteor Shower.** The Leonids is an average shower, producing up to 15 meteors per hour at its peak. This shower is unique in that it has a cyclonic peak about every 33 years where hundreds of meteors per hour can be seen. That last of these occurred in 2001. The Leonids is produced by dust grains left behind by comet Tempel-Tuttle, which was discovered in 1865. The shower runs annually from November 6-30. It peaks this year on the night of the 17th and morning of the 18th. Unfortunately the nearly full moon will dominate the sky this year, blocking all but the brightest meteors. But if you are patient, you should still be able to catch a few good ones. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Leo, but can appear anywhere in the sky.

November 19 - **Full Moon.** 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 08:59 UTC. This full moon was known by early Native American tribes as the Beaver Moon because this was the time of year to set the beaver traps before the swamps and rivers froze. It has also been known as the Frosty Moon and the Dark Moon.

November 19 - **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 eastern Russia, Japan, the Pacific Ocean, North America, Mexico, Central America, and parts of western South America. (**NASA Map and Eclipse Information**) Not visible from Europe!

December 4 - **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 07:44 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.

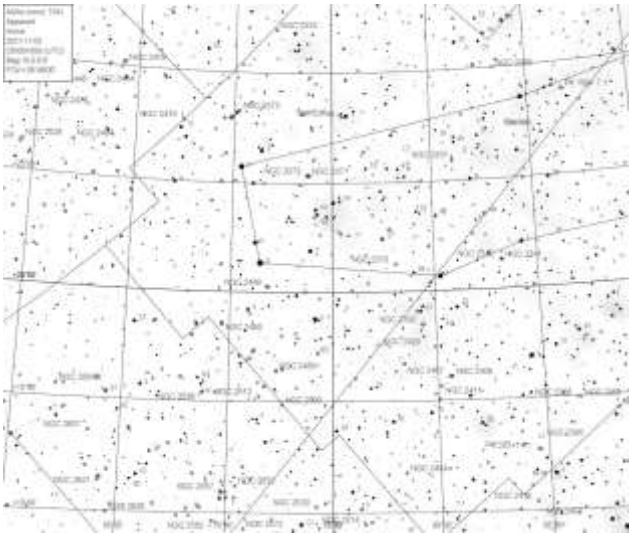
December 4- **Total Solar Eclipse.** A total solar eclipse occurs when the moon completely blocks the Sun, revealing the Sun's beautiful outer atmosphere known as the corona. The path of totality will for this eclipse will be limited to Antarctica and the southern Atlantic Ocean. A partial eclipse will bee visible throughout much of South Africa. (**NASA Map and Eclipse Information**) (**Interactive NASA Google**)

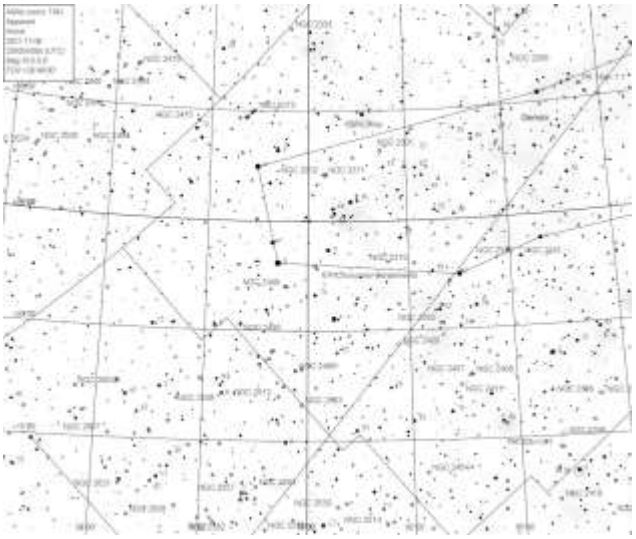
OBSERVING AND COORDINATION PROJECT FOR THIS WEEK: (3rd to 11th November 2021). COMET 67P and Rosetta mission follow up.

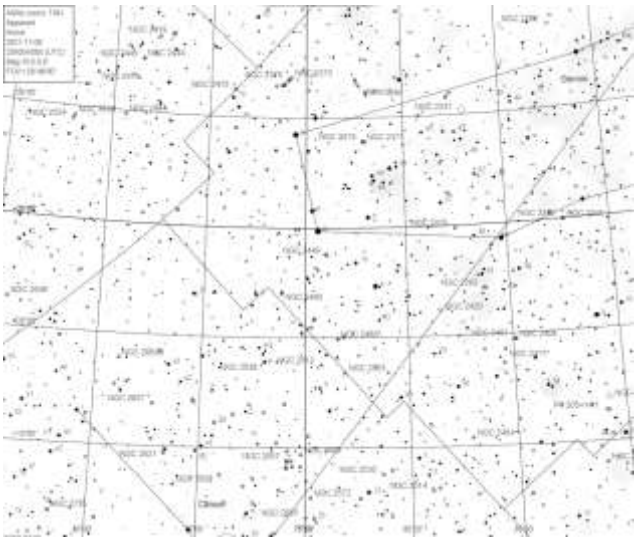
Helen UsherThe Society for Popular Astronomy

Hi All,
This is a post for comet observers, or potential comet observers!
Can you help us build on the legacy of the Rosetta Mission by gathering data on Comet 67P as it reaches perihelion again this week?
We would welcome any observations over the next 2 weeks, but particularly over the weekend of 5 - 8 November when it is predicted to be at its brightest, just after perihelion and before it gets closest to Earth on 13 November.
It is well placed in Gemini https://in-the-sky.org/news.php?id=20211103_19_100 so hopefully we can gather lots of great data!
We are looking for observations (in fits format) from a wide range of locations, with a wide range of equipment, and observation parameters.
What's the background to this?
I'm a PhD student at the Open University looking at the amateur data from the observing campaign in support of the Rosetta Mission to Comet 67P. I've also been looking at ways of making Pro-Am campaigns as effective as possible, and what tools can be provided for data collection and analysis. https://iopscience.iop.org/article/10.3847/PSJ/abca46
I'm looking for varied data set to test different analysis techniques, and an upload facility for a data archive.
We will ask for data submission when we have finished testing of the upload facility. So hold your data and supporting information for now.
We will be using the data in the FITS header cards as the starting point for the verification of meta data to be stored with the observations. We will also be requesting the following in addition to fits files:
- brief overview details of the observing sessions (to provide context)
- location and equipment (telescope, camera, filters)
- calibration state, and where possible calibration files (flats, darks, bias)
So could you please bear this in mind when setting up your observation runs, logging and saving your data.
We will, of course, credit observers and testers in any publications
If you have any questions then please contact me.
Thank you - and clear skies!!
Helen

Finder Charts for Comet 67P.



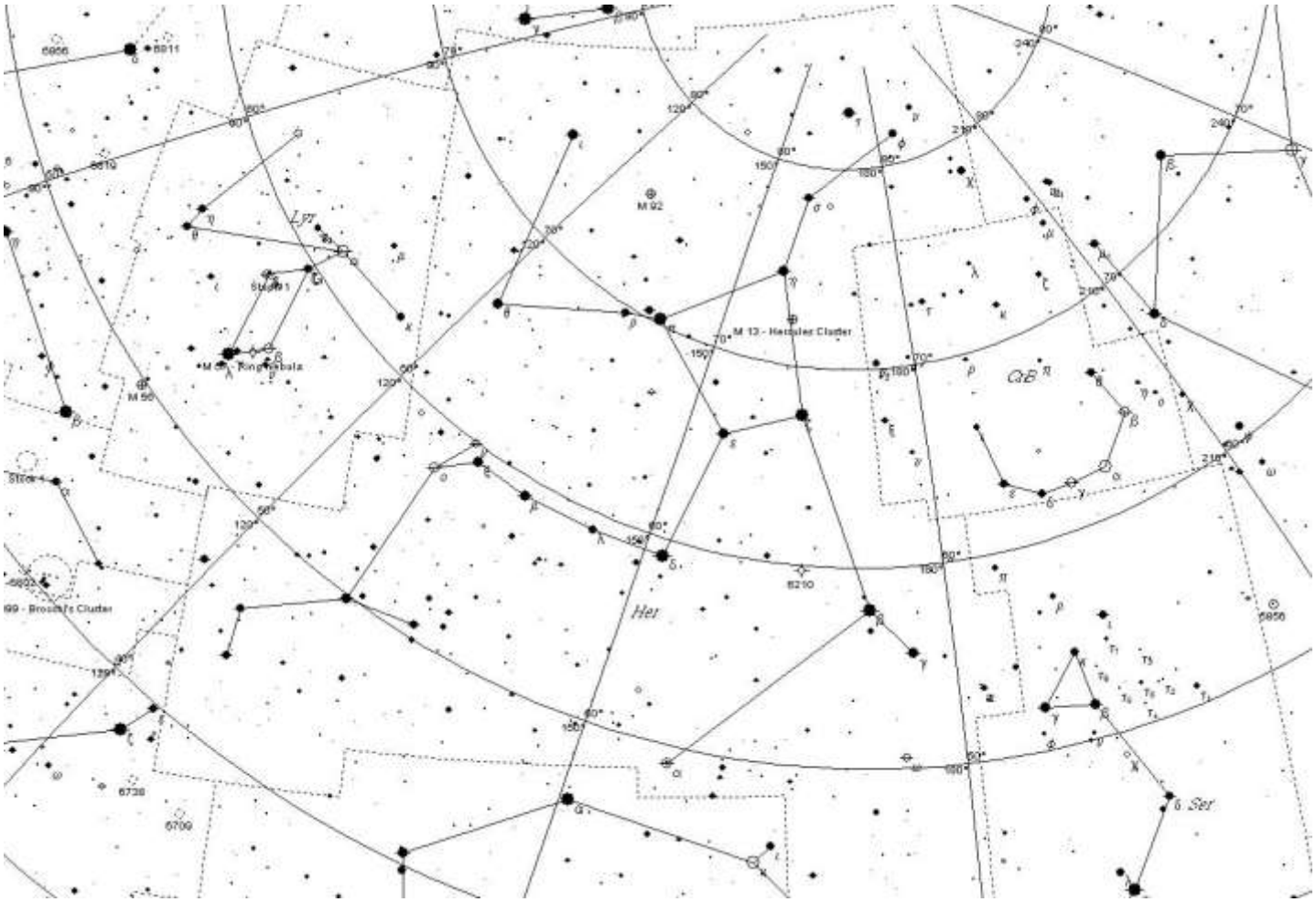




It is a 10th magnitude comet at this closest pass to the Earth, but it is the variability in brightness that the researcher is hoping to find.

Andy

CONSTELLATIONS OF THE MONTH: HERCULES



The constellation of Hercules belongs to one of the 48 originals plotted by Ptolemy and has survived time to become one of the 88 modern constellations adopted by the International Astronomical Union. Spanning an impressing 1225 square degrees of sky and containing 22 stars in the asterism, it has 106 Bayer/Flamsteed designated stellar designations. Hercules is bordered by the constellations of Draco, Bootes, Corona Borealis, Serpens Caput, Ophiuchus, Aquila, Sagitta, Vulpecula and Lyra. It is visible to all observers at latitudes between +90° and ?50° and is best seen at culmination during the month of July. There is one annual meteor shower associated with Hercules, the Tau Herculids, which peak on or near June 3. The radiant, or point of origin, is near the Hercules/Corona Borealis border and the meteor shower itself last about a month beginning around two weeks before and lasting about two weeks after the peak date. Most of these meteors are quite faint and at maximum, expect to see no more than 15 per hour average.

The mythology surrounding Hercules is a long and very colorful one. He was considered the greatest of all heroes – both Greek and Roman. The legendary strong man was supposed to be the son of Zeus; immortal, yet forever challenged by Hera by his circumstance of birth. His tasks were many: killing a lion with a hide that could not be punctured, destroying the many headed Hydra, cleaning out nasty stables, fighting birds with knife-like feathers, capturing a bull that breathed fire, taming horses that ate flesh, stealing cattle from monsters, stealing golden apples, fighting dragons, snatching a three-headed dog, loosing the love of his life, accidentally killing his teacher and so much more… It is no wonder that Hercules is so often depicted as kneeling in the sky! Even an immortal would be tired from so much… But at last, Hercules earned his place in the stars and he remains there to this day… The fifth largest constellation in the night sky.

Because the constellation of Hercules has no particularly bright stars, it is sometimes difficult to navigate through with binoculars until you learn a few “key” ingredients. There is a large asterism which is fairly easy to recognize that forms a lopsided box, referred to as the “keystone”. The northeast corner is Pi. The northwest corner is Eta. The southeast corner is Epsilon. The southwest corner is Zeta. Always remember when you look at a star chart that north and south are up and down… But east is to the left and west is to the right! To find the “keystone”, let bright Vega guide you…. just start by looking southwest.

Have you found Pi Herculis, yet? If you’re seeing two stars in your binoculars and you’re not sure which one, Pi is the slightly redder and slightly brighter of the pair. Situated about 370 light years from Earth, Pi Herculis is a cool, red supergiant star that was born about 140 million years ago. Although you can’t see it, Pi also has an orbiting substellar companion about 27 times larger than Jupiter there, too! Now, drop south for Epsilon – another binary star. Chances are good this pair of twin stars are almost identical to each other – about twice the size and mass of our Sun – and orbit each other so closely they nearly touch.

Don’t stop moving south. Our next stop is Gamma Herculis, the “8” shape on our map. Gamma is also a very cool star – one with a dead helium core that’s waiting to become a red giant. In maybe 8 million or so years, it will begin to fuse helium into carbon and become much brighter than it is tonight. If you see a faint companion star, it is only an optical one in binoculars – but Gamma is also a genuine binary star.

Next stop? Further south for Alpha – the "a" shape on our map. Now **here** is a great star! Named Rasalgethi and located about 380 light years away, here we have one of the finest double stars in the night sky. The primary star is a magnificent red class M supergiant that's over 475 more luminous than our Sun and whose size would fill up our solar system clear out to the orbit of the asteroid belt. But that's not all… Aim a telescope at Rasalgethi and you'll see it has a fifth magnitude companion five seconds of arc away. It is also a binary star – an F2 giant with a close orbiting dwarf star companion. Surrounding this whole system is an envelope of gas expelled from the primary star's incredible solar winds… Enjoy the unusual red and green hues of this colorful double star! And keep watching… Because Rasalgethi is also an irregular variable star – whose brightness changes from magnitude 2.7 to 4.0 within a period of about three months.

Next up? Return to the "keystone" and the northwest corner for Eta – the "n" shape on our map. Shining away about 50 times brighter than our own Sun at a distance of 112 light years, there is nothing particularly impressive about Eta, except where it leads. Begin moving your optics slowly south towards Zeta and you *will* encounter the "Great Hercules Cluster" – M13! Easily seen in binoculars, sometimes visible to the unaided eye in a dark sky location and absolutely magnificent in any telescope, Messier 13 is perhaps the most famous of all northern globular clusters. Located about 25,000 light years away and home to more than half a million stars, this 12 billion year old system spans no more than 100 light years across. Also known as NGC 6205, this impressive ball of stars was first discovered by Edmund Halley in 1714 and catalogued by Charles Messier on June 1, 1764. If you aren't impressed, then take the words of Kurt Vonnegut to heart: ""Every passing hour brings the Solar System forty-three thousand miles closer to Globular Cluster M13 in Hercules — and still there are some misfits who insist that there is no such thing as progress."

Ready for more? Then take another look at Eta and Pi and form an imaginary triangle on the sky using these two stars as the base. The apex is very near where you will find another amazing globular cluster for binoculars or small telescopes – Messier 92. First discovered by Johann Elert Bode in 1777 and independently rediscovered by Charles Messier on March 18, 1781, M92 is a 16 billion year old beauty – formed back at the Milky Way Galaxy's beginnings. Hiding in there are 16 variable stars and one rare eclipsing binary. What a treat to have two such bright objects so near to one another!

Ready for an alternative binocular tour of Hercules? Then let's use what you've learned. Start by locating magnificent M13 and move 3 degrees northwest – about a binocular field. What you will find is a splendid loose open cluster of stars known as Dolidze/Dzimselejsvili (DoDz) 5 – and it looks much like a miniature of the constellation Hercules. Just slightly more than 4 degrees to its east and just about a degree south of Eta Herculis is DoDz 6, which contains a perfect diamond pattern and an asterism of brighter stars resembling the constellation of Sagitta. Now we're going to move across the constellation of Hercules towards Lyra. East of the "keystone" is a tight configuration of three stars – Omicron, Nu, and Xi. About the same distance separating these stars northeast you will find DoDz 9. You'll see a pretty open cluster of around two dozen mixed magnitude stars. Now look again at the "keystone" and identify Lambda and Delta to the south. About midway between them and slightly southeast you will discover the stellar field of DoDz 8. This last is easy – all you need to do is return to Alpha. Move about 1 degree northwest (Rasalgethi will stay in the field) to discover the star-studded open cluster DoDz 7. These great open clusters are very much off the beaten path and will add a new dimension to binocular and fast-telescope observing!

Would you like a challenge? Then go back to M13 with a large telescope and take a look about 40 arc minutes to the northeast for NGC 6207 (RA 16:43.1 Dec +36:50). At near magnitude 12, this small spiral galaxy isn't for everyone, but it's always a smile a bonus when you're in the area, despite the lack of details. Try NGC 6210 (RA 16:44.5 Dec +23:49), too. This bright planetary nebula is suited for all telescopes and takes magnification very well. Look for a blue/green color in larger telescopes, and adding a nebula filter can sometimes reveal some subtle details of a shell around this one. But be sure to take the filter out if you want to catch the central star!

Sources: Chandra Observatory, SEDS

M13

M13 (with galaxy ngc 6207)

Almost seventy years ago, radio was exciting. People were still adjusting to its instantaneous connection with events from around the world as soon as they happened. Therefore, many listeners believed the dramatic presentation, presented as news during the radio play, was real. The broadcast has been followed by countless books, television shows and motion pictures which, combined, helped the notion of intelligent alien life to take firm roots in our culture. Science was also invaded by the possibility of extraterrestrial beings. In 1974, a carefully crafted message was transmitted from the world's largest radio telescope and directed towards stars in M13, pictured here, in hopes someone or something would be listening.

M13 is one of the most prominent and best-known globular clusters in the night sky. It is the brightest that can be easily seen with a small telescope or pair of binoculars from most places in the northern hemisphere. Located in the constellation of Hercules, M13 is visible this time of year. It is twenty thousand lights years from Earth and its 100,000 stars form a ball so immense that it takes light 150 years to travel from one side to the other. The age of M13 is estimated at about 14 billion years.

The 1974 three minute message to M13 was beamed into space from the Arecibo Radio Telescope, in Puerto Rico, and was spearheaded by Dr. Frank Drake, a leading SETI proponent and colleague of the late Carl Sagan. A much longer three-hour message to other carefully selected stars was subsequently transmitted in 2001 from a radio telescope in the Ukraine. Of course, if anyone is around when our 1974 message arrives at a hypothetical planet orbiting a star in M13, their response will

not return here until fifty thousand years have transpired.

This dazzling 1.2-hour exposure of M13 was produced by Cord Scholz from his imaging location in the northern German town of Hannover, which was also the birthplace of Wilhelm Herschel, the astronomer who discovered the planet Uranus. This image was taken with a 12.5 inch corrected newtonian telescope and an eleven mega-pixel camera. It also worth noting the number of far more distant galaxies that also fills this colorful picture.

Written by R. Jay GaBany

M92

Almost seventy years ago, radio was exciting. People were still adjusting to its instantaneous connection with events from around the world as soon as they happened. Therefore, many listeners believed the dramatic presentation, presented as news during the radio play, was real. The broadcast has been followed by countless books, television shows and motion pictures which, combined, helped the notion of intelligent alien life to take firm roots in our culture. Science was also invaded by the possibility of extra-terrestrial beings. In 1974, a carefully crafted message was transmitted from the world's largest radio telescope and directed towards stars in M13, pictured here, in hopes someone or something would be listening.

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Images Andy Burns

In Hercules is a huge ‘wall’ of galaxies at the 150-300 million light year range. I took some images last year, and the numbers were impossible to record against each galaxy without wiping out more so I used lines to indicate positions.

ISS PASSES For NOVEMBER and early DECEMBER 2021

from Heavens Above website maintained by Chris Peat.

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
01 Nov	-0.3	03:40:24	12°	E	03:40:24	12°	E	03:40:40	10°	E
01 Nov	-3.8	05:13:23	52°	W	05:14:08	85°	N	05:17:31	10°	E
02 Nov	-2.3	04:28:00	37°	E	04:28:00	37°	E	04:30:10	10°	E
02 Nov	-3.6	06:00:58	15°	W	06:03:36	68°	SSW	06:06:57	10°	ESE
03 Nov	-0.3	03:42:36	11°	E	03:42:36	11°	E	03:42:49	10°	E
03 Nov	-3.8	05:15:35	53°	W	05:16:16	81°	SSW	05:19:39	10°	ESE
04 Nov	-2.2	04:30:12	35°	E	04:30:12	35°	E	04:32:18	10°	E
04 Nov	-3.0	06:03:10	15°	W	06:05:36	40°	SSW	06:08:46	10°	SE
05 Nov	-0.2	03:44:50	11°	E	03:44:50	11°	E	03:44:54	10°	E
05 Nov	-3.5	05:17:49	47°	SW	05:18:17	53°	SSW	05:21:35	10°	SE
06 Nov	-1.9	04:32:29	29°	ESE	04:32:29	29°	ESE	04:34:18	10°	ESE
06 Nov	-2.0	06:05:27	14°	WSW	06:07:22	21°	SW	06:09:58	10°	SSE
07 Nov	-2.6	05:20:10	29°	SSW	05:20:10	29°	SSW	05:23:05	10°	SSE
08 Nov	-1.3	04:34:56	18°	SE	04:34:56	18°	SE	04:36:00	10°	SE
09 Nov	-1.4	05:22:46	13°	SSW	05:22:46	13°	SSW	05:23:40	10°	S
19 Nov	-0.8	19:00:17	10°	SSW	19:00:32	11°	SSW	19:00:32	11°	SSW
20 Nov	-1.8	18:13:16	10°	S	18:15:06	18°	SSE	18:15:06	18°	SSE
21 Nov	-1.5	17:26:38	10°	S	17:28:22	13°	SE	17:29:34	12°	ESE
21 Nov	-1.4	19:01:18	10°	SW	19:02:32	20°	SW	19:02:32	20°	SW
22 Nov	-2.9	18:13:54	10°	SW	18:16:56	36°	SSE	18:16:56	36°	SSE
23 Nov	-2.3	17:26:39	10°	SSW	17:29:32	27°	SSE	17:31:16	18°	ESE
23 Nov	-1.5	19:02:41	10°	WSW	19:04:14	25°	WSW	19:04:14	25°	WSW
24 Nov	-3.7	18:15:05	10°	WSW	18:18:26	64°	SSE	18:18:31	64°	SSE
25 Nov	-3.2	17:27:34	10°	SW	17:30:50	49°	SSE	17:32:45	22°	E
25 Nov	-1.4	19:04:10	10°	W	19:05:42	25°	W	19:05:42	25°	W
26 Nov	-3.9	18:16:29	10°	W	18:19:53	89°	S	18:19:54	88°	ESE
27 Nov	-3.7	17:28:49	10°	WSW	17:32:12	78°	SSE	17:34:06	24°	E
27 Nov	-1.3	19:05:37	10°	W	19:07:03	23°	W	19:07:03	23°	W
28 Nov	-3.4	16:41:11	10°	WSW	16:44:31	64°	SSE	16:47:53	10°	E
28 Nov	-3.8	18:17:55	10°	W	18:21:13	83°	NW	18:21:13	83°	NW
29 Nov	-3.8	17:30:11	10°	W	17:33:35	86°	N	17:35:25	25°	E
29 Nov	-1.2	19:07:01	10°	W	19:08:21	22°	W	19:08:21	22°	W
30 Nov	-3.7	16:42:28	10°	W	16:45:51	88°	SSE	16:49:14	10°	E
30 Nov	-3.7	18:19:17	10°	W	18:22:34	79°	SW	18:22:34	79°	SW
01 Dec	-3.8	17:31:33	10°	W	17:34:56	89°	N	17:36:48	24°	E
01 Dec	-1.1	19:08:24	10°	W	19:09:45	21°	W	19:09:45	21°	W
02 Dec	-3.8	16:43:47	10°	W	16:47:10	85°	N	16:50:34	10°	E
02 Dec	-3.3	18:20:36	10°	W	18:23:55	53°	SSW	18:24:03	53°	S
03 Dec	-3.5	17:32:50	10°	W	17:36:11	68°	SSW	17:38:26	19°	ESE
03 Dec	-0.9	19:09:58	10°	W	19:11:24	18°	WSW	19:11:24	18°	WSW
04 Dec	-3.7	16:45:02	10°	W	16:48:25	82°	SSW	16:51:49	10°	ESE
04 Dec	-2.1	18:21:59	10°	W	18:24:58	29°	SSW	18:25:54	25°	S
05 Dec	-2.5	17:34:05	10°	W	17:37:17	40°	SSW	17:40:28	10°	SE
05 Dec	-0.5	19:13:16	10°	SW	19:13:22	10°	SW	19:13:29	10°	SW
06 Dec	-3.0	16:46:15	10°	W	16:49:33	54°	SSW	16:52:51	10°	ESE
06 Dec	-0.8	18:23:47	10°	WSW	18:25:49	15°	SW	18:27:49	10°	S
07 Dec	-1.2	17:35:32	10°	W	17:38:11	21°	SW	17:40:49	10°	SSE
08 Dec	-1.6	16:47:30	10°	W	16:50:30	30°	SSW	16:53:29	10°	SSE
09 Dec	-0.1	17:38:24	10°	SW	17:38:51	10°	SW	17:39:18	10°	SW
10 Dec	-0.5	16:49:10	10°	WSW	16:51:14	15°	SW	16:53:17	10°	S

END IMAGES, OBSERVING AND OUTREACH

With a lot of excitement from the press about a mass coronal ejection hitting the Earth with near Carrington event levels of plasma I though I would image the Sun in white light today.
Quite a bit of thin cloud, but three sunspot regions visible.
In the end the event was the usual over hyped alarm, the plasma to longer to arrive than estimated and considerable weaker.
Some nice views from Finland and Iceland and narrow bands from North of Scotland and even north coast of Wales. The Kp was around 175 at peak, we need around 225Kp to see anything from Wiltshire...
Andy

Observing Sessions and Covid19 - Update

Proposed Observation Sessions for 2021-2022

With the start of the WAS face to face meetings at Seend this month, the Observing Team would also like to announce that we will be starting observation evenings for the 2021-2021 season.

Any observing meetings will need to to be safe and follow social distancing recommendations.
A reminder email shall be sent out early on in the week to inform you of the planned event but it should also be noted that like the weather, Government guidelines may change at any time and therefore the usual email will be sent out by 16:00 on the day giving notice of whether observing is 'ON' or 'OFF' that evening, so look out for these. If a session is cancelled we may then possibly plan a new different date.

Planned observing evenings will be on a Friday night in the Lacock playing fields behind the Red Lion pub at 19:00 or an Hour after sunset depending on the time of year.
With the New Moon being around the beginning of the month and the full moon generally around the middle, the following dates for observing are proposed:

- **Friday 26 November 2021**
- **Friday 03 December 2021 or/and Christmas Week Meet tba.**
- **Friday 28 January 2022**
- **Friday 25 February 2022**
- **Friday 25 March 2022 (Messier Marathon)**
- **Friday 29 April 2022**
- **Friday 27 May 2022**
- **Friday 03 June 2022 (limited sky darkness)**

The final decision on the planned dates will be advised shortly and published on the website :https://wasnet.org.uk/observing/ **but we shall also try to arrange special evenings for events such as meteor showers/ Lunar eclipses etc.**
Also if members wish to propose a ad-hoc session for other reasons and at other locations, such as astro-photography, solar observing etc, with other like-minded members then they can do so through the Society Members Facebook Page or through the WAS contact page on the website.

OUTREACH

Zoom sessions and Google Classroom sessions have kept outreach going to schools

On July 20th I did a real session on the international lunar day to a group of around 50 pensioners at the Wadswick Green retirement centre.

If any schools or clubs are interested in having talks from WAS please contact Andy Burns.

Dark Skies Wales are starting their live observing sessions, but talks are delayed.