NWASNEWS

Volume27 Issue 9

May 2022

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

Seend Hall Meeting

Don't forget tonight marks the return to our hall meetings.

Running forward from this will depend on the attendees at the meeting. I know of 3 who are not able to make the meeting. If we get low numbers it might be necessary to go back to Zoom. If Bill Gates synopsis of the COVID virus is right, we may not be out of the woods yet. I advise masks to be worn where possible.

June is in the balance, the hall is having building work and may not be available, I will not know more until I meet Jo at the hall.

Some speakers in the future will be Zoom only and hopefully we can work this into the hall.

Observing sessions have been going very well but we were unlucky with the weather clearing at midnight on Friday, hopefully this Friday 6th May will be clear. Chris will keep us up to date on this.

The AGM is due in June and there are some positions that need to be filled. A regular hall contact, who is local to Seend, also a Teas/Coffee/Kitchen host.

The treasure would also like to step back from his duties and if anyone would like to try out the chair person position I would be happy for a run in period to hand over the reigns.

This evenings speaker is the hugely entertaining Andrew Lound who will be taking us back the early Apollo mission, with particular reference to the mission that went round the Moon, Apollo 8. This was a tremendous technological leap for manned missions, and with Artemis going ahead again we could be back on the Moon as a species in the not too distant future.

A faint link to Apollo 8 which landed back on Earth on Christmas Day 1968, the James Webb Telescope launched on Christmas Day 2021, and engineering work chilling the systems down to working temperature and aligning mirrors for Infrared imaging use has been progressing more quickly tan originally allowed. This will mean an even longer life for this research telescope. Some good news at last.

Clear skies Andy

In mid-March I went on a last minute cruise to Norway in the hope of viewing the Aurora Borealis.
Initial conditions were not good with sea fog, snow, icy decks, high winds etc. Well, it was the North Sea in winter!
However, on 28th March we crossed the Arctic Circle. That evening in the Norwegian Sea the sky cleared and I could see the Aurora so I went to my cabin to grab my camera gear.

John Dartnell
See more on the emails page.

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 2021/22

2022

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?

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)

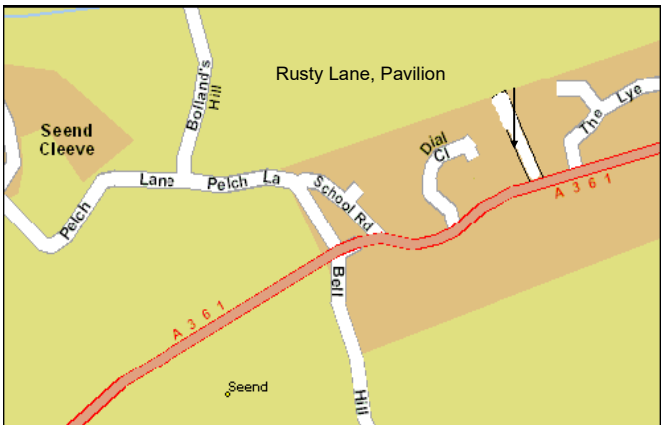
Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

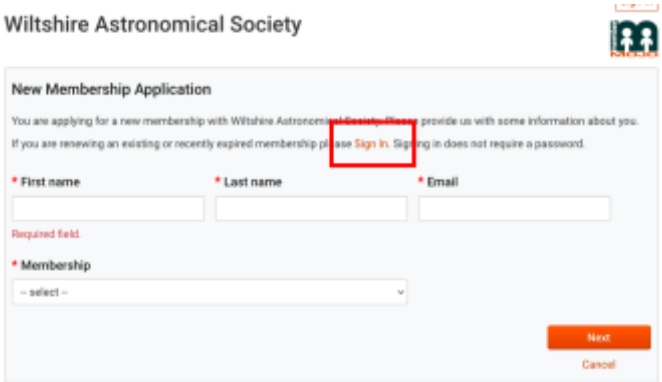
Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



Observing Sessions see back page



Andrew Lound.

Presenter, writer, lecturer and broadcaster. Former curator of the Avery Historical Museum. Regular commentator on science and history matters on BBC Radio and Talk Radio. Writer and presenter of TV series 'Streets of Birmingham'. Published 4 books (3 history and one biography). Tours the country with his trademark Odyssey Dramatic Presentations® in history and science subjects, having been involved in over 5000 events. Has toured in USA, Europe and North Africa. Presentations contain music, audio FX, SFX and presented in costume.

Apollo 8 was the first crewed spacecraft to leave low Earth orbit and the first human spaceflight to reach the Moon. The crew orbited the Moon ten times without landing, and then departed safely back to Earth.[1][2][3] These three astronauts—Frank Borman, James Lovell, and William Anders—were the first humans to personally witness and photograph the far side of the Moon and an Earthrise

Swindon's own astronomy group

Physical meetings continuing!

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

Next meeting: Hugh Allen

Our speaker on the 20 May will be Hugh Allen who will be speaking on 'Binary Stars - A history of making waves'.

Hugh is an industrial chemist with a career in the printing ink industry, having studied Natural Sciences at Downing College, Cambridge. His interest in astronomy became a passion (some would say obsession) when his wife bought him a telescope in 2008. He started with visual observing and then astrophotography. In the last 8 years or so spectroscopy has become his main focus, the passion for which he shares through talks and courses. He is Chairman of the Wells & Mendip Astronomers and a member of the Herschel Society in Bath.

His talk: Binary stars have a history of making waves in all branches of astronomy; the detections by the Laser Interferometer Gravitational-Wave Observatory (LIGO) are just the latest and maybe greatest example. The talk will use some of the speaker's own images and spectroscopic observations to illuminate the impact of binary stars on the history and science of astronomy.

Ad-hoc viewing sessions postponed

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

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

Membership of Swindon Stargazers is required for insurance purposes (PLI)

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 2022

Friday, 17 June 19.30 onwards

Programme: Steve Tonkin - Journey Into Space

----------Summer Break----------

Friday, 16 September 19.30 onwards

Programme: Kate Earl - Secret Stowaways

Friday, 21 October 19.30 onwards

Programme: Mark Radice - Deep Sky Observing

Friday, 18 November 19.30 onwards

Programme: Richard Fleet - The Winchcombe Meteorite

Friday, 9 December 19.30 onwards

Programme: Christmas Social

Website: http://www.swindonstargazers.com

Chairman: Robin Wilkey

Tel No: 07808 775630
Email: robin@wilkey.org.uk
Address: 61 Northern Road
Swindon, SN2 1PD

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Tel No: 01793 574403
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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 Veny near Warminster.

BATH ASTRONOMERS

GRESHAM ON LINE SESSIONS

JUNE
Life in the Universe by Professor Katherine Blundell
Wednesday, June 1, 2022 6:00 PM gres.hm/life-universe
Museum of London / Online Or watch later
How can life form in the Universe, and what are the necessary ingredients for habitability so that planets can sustain life? Can we expect life elsewhere in the solar system, or on exo-planets? This lecture offers a broader perspective from astrobiology, astrochemistry, and astrophysics on the habitability or otherwise of other planets beyond Planet Earth.
Their website
www.gresham.ac.uk
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Best wishes for the new Year
Martin
Martin Baker

FAS News and from other societies:

Dear FAS Member

Just a reminder of the free, two-day, international Zoom webinar *The Challenge of Megaconstellations* organised by the FAS and an updated programme for you to send out to your members.

There will be 20 talks of 25 minutes each given by 20 speakers from Australia, Canada, Chile, Germany, the UK and the USA.

The level is aimed at the interested amateur up to early-career post-doctorate researcher so is specifically for those who will be *doing* astronomy over the next couple of decades to be prepared for the challenge of LEO satellite megaconstellations.

For free registration members can go to the FAS website and follow the links (or click on this link) to see the megaconstellation page. At the foot of that page click on the link to the Zoom webinar registration page; you just need to provide your name and a confirmed email address and click on the blue 'Register' button and Zoom will send you the joining link which works for both days.

I urge you to please forward this to your members as soon as possible so that they can register for this, our biggest event yet!

Best wishes

Paul

APOLLO 8

Apollo 8 was the first crewed spacecraft to leave low Earth orbit and the first human spaceflight to reach the Moon. The crew orbited the Moon ten times without landing, and then departed safely back to Earth.[1][2][3] These three astronauts—Frank Borman, James Lovell, and William Anders—were the first humans to personally witness and photograph the far side of the Moon and an Earthrise.

Apollo 8 launched on December 21, 1968, and was the second crewed spaceflight mission flown in the United States Apollo space program after Apollo 7, which stayed in Earth orbit. Apollo 8 was the third flight and the first crewed launch of the Saturn V rocket, and was the first human spaceflight from the Kennedy Space Center, located adjacent to Cape Kennedy Air Force Station in Florida.

Originally planned as the second crewed Apollo Lunar Module and command module test, to be flown in an elliptical medium Earth orbit in early 1969, the mission profile was changed in August 1968 to a more ambitious command-module-only lunar orbital flight to be flown in December, as the lunar module was not yet ready to make its first flight. Astronaut Jim McDivitt's crew, who were training to fly the first lunar module flight in low Earth orbit, became the crew for the Apollo 9 mission, and Borman's crew were moved to the Apollo 8 mission. This left Borman's crew with two to three months' less training and preparation time than originally planned, and replaced the planned lunar module training with translunar navigation training.

Apollo 8 took 68 hours (almost three days) to travel the distance to the Moon. The crew orbited the Moon ten times over the course of twenty hours, during which they made a Christmas Eve television broadcast in which they read the first ten verses from the Book of Genesis. At the time, the broadcast was the most watched TV program ever. Apollo 8's successful mission paved the way for Apollo 11 to fulfil U.S. president John F. Kennedy's goal of landing a man on the Moon before the end of the decade. The Apollo 8 astronauts returned to Earth on December 27, 1968, when their spacecraft splashed down in the northern Pacific Ocean. The crew members were named *Time* magazine's "Men of the Year" for 1968 upon their return.

The initial crew assignment of Frank Borman as Commander, Michael Collins as Command Module Pilot (CMP) and William Anders as Lunar Module Pilot (LMP) for the third crewed Apollo flight was officially announced on November 20, 1967. Collins was replaced by Jim Lovell in July 1968, after suffering a cervical disc herniation that required surgery to repair. This crew was unique among pre-Space Shuttle era missions in that the commander was not the most experienced member of the crew: Lovell had flown twice before, on Gemini VII and Gemini XII. This would also be the first case of a commander of a previous mission (Lovell, Gemini XII) flying as a non-commander. This was also the first mission to reunite crewmates from a previous mission (Lovell and Borman, Gemini VII).

As of April, 2022, all three Apollo 8 astronauts remain alive.

During Projects Mercury and Gemini, each mission had a prime and a backup crew. For Apollo, a third crew of astronauts was added, known as the support crew. The support crew maintained the flight plan, checklists, and mission ground rules, and ensured that the prime and backup crews were apprised of any changes. The support crew developed procedures in the simulators, especially those for emergency situations, so that the prime and backup crews could practice and master them in their simulator training, For Apollo 8, the support crew consisted of Ken Mattingly, Vance Brand, and Gerald Carr.

The capsule communicator (CAPCOM) was an astronaut at the Mission Control Center in Houston, Texas, who was the only person who communicated directly with the flight crew. For Apollo 8, the CAPCOMs were Michael Collins, Gerald Carr, Ken Mattingly, Neil Armstrong, Buzz Aldrin, Vance Brand, and Fred Haise

The mission control teams rotated in three shifts, each led by a flight director. The directors for Apollo 8 were Clifford E. Charlesworth (Green team), Glynn Lunney (Black team), and Milton Windler (Maroon team

On September 20, 1967, NASA adopted a seven-step plan for Apollo missions, with the final step being a Moon landing. Apollo 4 and Apollo 6 were "A" missions, tests of the Saturn V launch vehicle using an uncrewed Block I production model of the command and service module (CSM) in Earth orbit. Apollo 5 was a "B" mission, a test of the LM in Earth orbit. Apollo 7, scheduled for October 1968, would be a "C" mission, a crewed Earth-orbit flight of the CSM. Further missions depended on the readiness of the LM. It had been decided as early as May 1967 that there would be at least four additional missions. Apollo 8 was planned as the "D" mission, a test of the LM in a low Earth orbit in December 1968 by James McDivitt, David Scott, and Russell Schweickart, while Borman's crew would fly the "E" mission, a more rigorous LM test in an elliptical medium Earth orbit as Apollo 9, in early 1969. The "F" Mission would test the CSM and LM in lunar orbit, and the "G" mission would be the finale, the Moon landing.

The first stage of AS-503 being erected in the Vehicle Assembly Building (VAB) on February 1, 1968

Production of the LM fell behind schedule, and when Apollo 8's LM-3 arrived at the Kennedy Space Center (KSC) in

June 1968, more than a hundred significant defects were discovered, leading Bob Gilruth, the director of the Manned Spacecraft Center (MSC), and others to conclude that there was no prospect of LM-3 being ready to fly in 1968. Indeed, it was possible that delivery would slip to February or March 1969. Following the original seven-step plan would have meant delaying the "D" and subsequent missions, and endangering the program's goal of a lunar landing before the end of 1969. George Low, the Manager of the Apollo Spacecraft Program Office, proposed a solution in August 1968 to keep the program on track despite the LM delay. Since the next CSM (designated as "CSM-103") would be ready three months before LM-3, a CSM-only mission could be flown in December 1968. Instead of repeating the "C" mission flight of Apollo 7, this CSM could be sent all the way to the Moon, with the possibility of entering a lunar orbit and returning to Earth. The new mission would also allow NASA to test lunar landing procedures that would otherwise have had to wait until Apollo 10, the scheduled "F" mission. This also meant that the medium Earth orbit "E" mission could be dispensed with. The net result was that only the "D" mission had to be delayed, and the plan for lunar landing in mid-1969 could remain on timeline.

On August 9, 1968, Low discussed the idea with Gilruth, Flight Director Chris Kraft, and the Director of Flight Crew Operations, Donald Slayton. They then flew to the Marshall Space Flight Center (MSFC) in Huntsville, Alabama, where they met with KSC Director Kurt Debus, Apollo Program Director Samuel C. Phillips, Rocco Petrone, and Wernher von Braun. Kraft considered the proposal feasible from a flight control standpoint; Debus and Petrone agreed that the next Saturn V, AS-503, could be made ready by December 1; and von Braun was confident the pogo oscillation problems that had afflicted Apollo 6 had been fixed. Almost every senior manager at NASA agreed with this new mission, citing confidence in both the hardware and the personnel, along with the potential for a circumlunar flight providing a significant morale boost. The only person who needed some convincing was James E. Webb, the NASA administrator. Backed by the full support of his agency, Webb authorized the mission. Apollo 8 was officially changed from a "D" mission to a "C-Prime" lunar-orbit mission.

With the change in mission for Apollo 8, Slayton asked McDivitt if he still wanted to fly it. McDivitt turned it down; his crew had spent a great deal of time preparing to test the LM, and that was what he still wanted to do. Slayton then decided to swap the prime and backup crews of the D and E missions. This swap also meant a swap of spacecraft, requiring Borman's crew to use CSM-103, while McDivitt's crew would use CSM-104, since CM-104 could not be made ready by December. David Scott was not happy about giving up CM-103, the testing of which he had closely supervised, for CM-104, although the two were almost identical, and Anders was less than enthusiastic about being an LMP on a flight with no LM. Instead, in order that the spacecraft would have the correct weight and balance, Apollo 8 would carry a LM test article, a boilerplate model of LM-3.

Added pressure on the Apollo program to make its 1969 landing goal was provided by the Soviet Union's Zond 5 mission, which flew some living creatures, including Russian tortoises, in a cislunar loop around the Moon and returned them to Earth on September 21.[37] There was speculation within NASA and the press that they might be preparing to launch cosmonauts on a similar circumlunar mission before the end of 1968.[38] Compounding these concerns, American reconnaissance satellites observed a mockup N1 being rolled to the pad at Baikonur in November 1967, with more activity in 1968.[39]

Erection and mating of spacecraft 103 to Launch Vehicle AS-503 in the VAB for the Apollo 8 mission

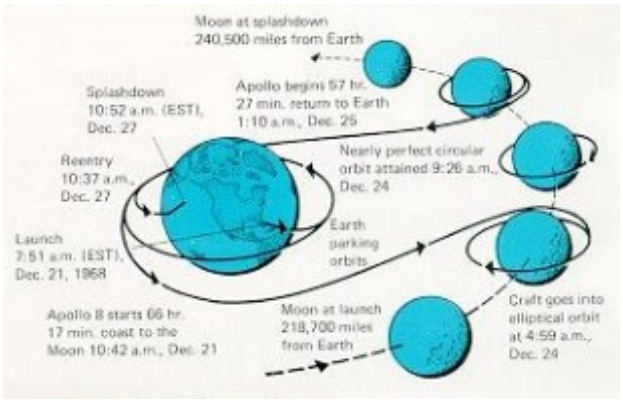
The Apollo 8 crew, now living in the crew quarters at Kennedy Space Center, received a visit from Charles Lindbergh and his wife, Anne Morrow Lindbergh, the night before the launch. They talked about how, before his 1927 flight, Lindbergh had used a piece of string to measure the distance from New York City to Paris on a globe and from that calculated the fuel needed for the flight. The total he had carried was a tenth of the amount that the Saturn V would burn every second. The next day, the Lindberghs watched the launch of Apollo 8 from a nearby dune

As the first crewed spacecraft to orbit more than one celestial body, Apollo 8's profile had two different sets of orbital parameters, separated by a translunar injection maneuver. Apollo lunar missions would begin with a nominal 100-nautical-mile (185.2 km) circular Earth parking orbit. Apollo 8 was launched into an initial orbit with an apogee of 99.99 nautical miles (185.18 km) and a perigee of 99.57 nautical miles (184.40 km), with an inclination of 32.51° to the Equator, and an orbital period of 88.19 minutes. Propellant venting increased the apogee by 6.4 nautical miles (11.9 km) over the 2 hours, 44 minutes, and 30 seconds spent in the parking orbit.

This was followed by a trans-lunar injection (TLI) burn of the S-IVB third stage for 318 seconds, accelerating the 63,650 lb (28,870 kg) command and service module and 19,900 lb (9,000 kg) LM test article from an orbital velocity of 25,567 feet per second (7,793 m/s) to the injection velocity of 35,505 ft/s (10,822 m/s) which set a record for the highest speed, relative to Earth, that humans had ever travelled. This speed was slightly less than the Earth's escape velocity of 36,747 feet per second (11,200 m/s), but put Apollo 8 into an elongated elliptical Earth orbit, close enough to the Moon to be captured by the Moon's gravity.

The standard lunar orbit for Apollo missions was planned as a nominal 60-nautical-mile (110 km) circular orbit above the Moon's surface. Initial lunar orbit insertion was an ellipse with a perilune of 60.0 nautical miles (111.1 km) and an apolune of 168.5 nautical miles (312.1 km), at an inclination of 12° from the lunar equator. This was then circularized at 60.7 by 59.7 nautical miles (112.4 by 110.6 km), with an orbital period of 128.7 minutes.] The effect of lunar mass concentrations ("mascons") on the orbit was found to be greater than initially predicted; over the course of the ten lunar orbits lasting twenty hours, the orbital distance was perturbated to 63.6 by 58.6 nautical miles (117.8 by 108.5 km).

Apollo 8 achieved a maximum distance from Earth of 203,752 nautical miles (234,474 statute miles; 377,349 kilometers).



When the spacecraft came out from behind the Moon for its fourth pass across the front, the crew witnessed an "Earthrise" in person for the first time in human history. NASA's Lunar Orbiter 1 had taken the first picture of an Earthrise from the vicinity of the Moon, on August 23, 1966. Anders saw the Earth emerging from behind the lunar horizon and called in excitement to the others, taking a black-and-white photograph as he did so. Anders asked Lovell for colour film and then took *Earthrise*, a now famous color photo, later picked by *Life* magazine as one of its hundred photos of the century.

Due to the synchronous rotation of the Moon about the Earth, Earthrise is not generally visible from the lunar surface. This is because, as seen from any one place on the Moon's surface, Earth remains in approximately the same position in the lunar sky, either above or below the horizon. Earthrise is generally visible only while orbiting the Moon, and at selected surface locations near the Moon's limb, where libration carries the Earth slightly above and below the lunar horizon.

Anders continued to take photographs while Lovell assumed control of the spacecraft so that Borman could rest. Despite the difficulty resting in the cramped and noisy spacecraft, Borman was able to sleep for two orbits, awakening periodically to ask questions about their status. Borman awoke fully when he started to hear his fellow crew members make mistakes. They were beginning to not understand questions and had to ask for the answers to be repeated. Borman realized that everyone was extremely tired from not having a good night's sleep in over three days. He ordered Anders and Lovell to get some sleep and that the rest of the flight plan regarding observing the Moon be scrubbed. Anders initially protested, saying that he was fine, but Borman would not be swayed. Anders finally agreed under the condition that Borman would set up the camera to continue to take automatic pictures of the Moon. Borman also remembered that there was a second television broadcast planned, and with so many people expected to be watching, he wanted the crew to be alert. For the next two orbits, Anders and Lovell slept while Borman sat at the helm.

As they rounded the Moon for the ninth time, the astronauts began the second television transmission. Borman introduced the crew, followed by each man giving his impression of the lunar surface and what it was like to be orbiting the Moon. Borman described it as being "a vast, lonely, forbidding expanse of nothing". Then, after talking about what they were flying over, Anders said that the crew had a message for all those on Earth. Each man on board read a section from the Biblical creation story from the Book of Genesis. Borman finished the broadcast by wishing a Merry Christmas to everyone on Earth. His message appeared to sum up the feelings that all three crewmen had from their vantage point in lunar orbit. Borman said, "And from the crew of Apollo 8, we close with good night, good luck, a Merry Christmas and God bless all of you—all of you on the good Earth.

The only task left for the crew at this point was to perform the trans-Earth injection (TEI), which was scheduled for 2+1⁄2 hours after the end of the television transmission. The TEI was the most critical burn of the flight, as any failure of the SPS to ignite would strand the crew in lunar orbit, with little hope of escape. As with the previous burn, the crew had to perform the manoeuvre above the far side of the Moon, out of contact with Earth. The burn occurred exactly on time. The spacecraft telemetry was reacquired as it re-emerged from behind the Moon at 89 hours, 28 minutes, and 39 seconds, the exact time calculated. When voice contact was regained, Lovell announced, "Please be informed, there is a Santa Claus", to which Ken Mattingly, the current CAPCOM, replied, "That's affirmative, you are the best ones to know, The spacecraft began its journey back to Earth on December 25, Christmas Day.

SPACE NEWS TO MAY 22

China is Building an Asteroid Deflection Mission of its own, due for Launch in 2025

There's an old joke that the dinosaurs are only extinct because they didn't develop a space agency. The implication, of course, is that unlike our reptilian ancestors, we humans might be able to save ourselves from an impending asteroid strike on Earth, given our six-and-a-half decades of spaceflight experience. But the fact is that while we have achieved amazing things since Sputnik kicked off the space age in 1957, very little effort thus far has gone into developing asteroid deflection technologies. We are woefully inexperienced in this arena, and aside from our Hollywood dramatizations of it, we've never yet put our capabilities to the test. But that's about to change.

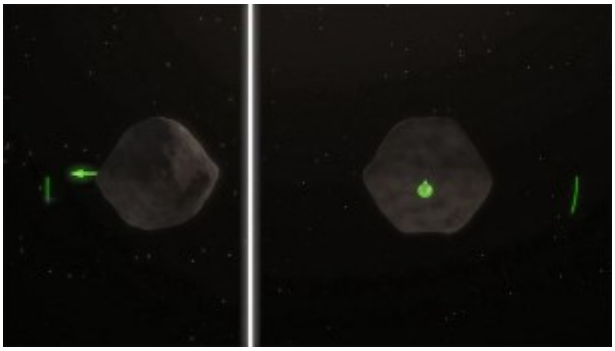
Wu Yanhua, deputy head of the China National Space Administration (CNSA), announced last week that they plan to carry out an asteroid deflection test as early as 2025 – part of a larger asteroid monitoring and defense system that the CNSA is in the early stages of developing. The monitoring system will consist of both ground-based and space-based instruments, used to catalog near-Earth objects that may pose a threat.

Monitoring systems are especially important because the earlier you catch an incoming asteroid, the easier it is to deflect. A distant asteroid might need only a minor tap to redirect it enough to miss Earth – the later an asteroid is seen, the more difficult it would be to change its course.

You can sleep well knowing that space agencies around the world have already built robust asteroid monitoring systems, and have cataloged many thousands of solar system objects. None of them pose a realistic threat in our lifetimes (currently, the highest risk object, known as 2010 RF12, has a 4.8% chance of an Earth impact in 2095. This 7-meter asteroid would cause a fireball similar to the Chelyabinsk meteor in 2013). Still, there may be more out there we haven't seen yet, so the CNSA's new monitoring project is a welcome addition.

When it comes to asteroid hunting, the smallest objects are the hardest to see, but, like the shooting stars that streak harmlessly through the sky every night of the year, these are unlikely to cause damage. On the other end of the spectrum, the largest asteroids out there are capable of causing an extinction-level event, but are easy to spot and keep track of. It is actually the middle-sized asteroids that are the most dangerous – big enough to do localized damage, but small enough that we may not find them in time.

Observing asteroids up close also helps us understand how best to deflect them. NASA's OSIRIS-Rex mission, which recently visited near-Earth asteroid Bennu, discovered Bennu to be a loose, gravel pit of an asteroid. Such a target would require a different technique to deflect it than a homogenous, solid chunk of rock. With enough time and warning, potential options include a gravity tractor (gently tugging at the asteroid with the mass of a spacecraft orbiting it) or painting the exterior of the asteroid white (changing the way the asteroid is heated and cooled by the Sun, slowly affecting its orbit via the Yarkovsky effect).



A "gravity tractor" planetary defense technique that leverages the mass of a spacecraft to impart a gravitational force on an asteroid, slowly altering the asteroid's trajectory. Credit: NASA.

The simplest solution, of course, is to just hit an asteroid really hard.

The CNSA's new monitoring program will be paired with an engineering effort to design and build a high thrust rocket that can carry a kinetic impactor: a payload designed to punch an asteroid with enough force to change its orbit. The target asteroid they plan to test the impactor on is, as yet, unannounced.

NASA and ESA are also taking their first steps toward developing kinetic asteroid defense capabilities.
NASA's DART mission, launched last November, will attempt to change the orbit of Dimorphos, a tiny moon circling asteroid Didymos, by slamming into the moon at high speed. This is the first test of its kind, and the resulting change in trajectory is likely to be very small. This is, in large part, the reason DART is targeting a moon rather than a lone asteroid: it will be easier to measure the tiny changes in Dimorphos' orbit with nearby asteroid Didymos available to provide a frame of reference.

The DART mission will impact Dimorphos in September of this year, and will be followed up in 2027 with Hera, an ESA mission that will observe the aftermath of the impact up close.

The existential threat of an asteroid impact is small in the short term, but is almost certain in the (very) long term. As such, asteroid monitoring systems and deflection tests like DART and the CNSA's new impactor project are important first steps to keeping Earth safe, and making sure we don't go the way of the dinosaurs. Now, if only we could get climate change under control…

Featured image: Artist's impression of NASA's DART mission. Credit: NASA/JHUAPL/Steve Gribben.

A New Kind of Stellar Explosion Has Been Discovered: Micronovae

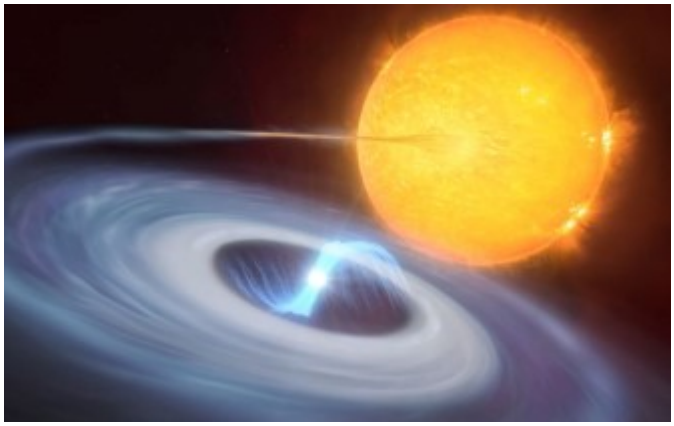
The most energetic explosions in the Universe come from stars called supernovae. These galactic bombs have the energy of about 10^{28} mega-tons. After they detonate, the only thing left behind is either a neutron star or black hole. Another type of stellar explosion is known as a nova which has much less energy and covers the surface of a white dwarf.

Now, a team of astronomers recently discovered a new type of stellar explosion akin to supernovae and novae but with much less energy, and they're calling it a micronova.

There are two types of supernovae, type I and type II. The first type happens in a binary star system, where two stars are gravitationally bound by each other, one being a white dwarf. The white dwarf collects matter from its companion star and eventually explodes, leaving nothing behind. The second type occurs when a star with enough mass, estimated to be in the range of eight to fifteen solar masses, runs out of nuclear fuel and its core collapses. The rebound from the collapse causes its outer layers to expand outward, leaving behind a neutron star or black hole.

A nova also happens on a white dwarf star in a binary star system and when enough material gathers on the surface of the star, a fusion reaction happens causing an explosion that engulfs the whole surface. This blast emits as much energy as our sun releases in 10,000 years.

Novae occurring on white dwarfs in a binary star system cover the entire star's surface. However, while the newly discovered micronovae are caused by the same thing, these explosions happen when the material accreted onto the white dwarf from its companion accumulates at its magnetic poles. Novae can last for several weeks, but micronovae last only a few hours.



Artist's impression of a micronova Credit: ESO

While examining data collected from NASA's Transiting Exoplanet Survey Satellite (TESS), the astronomers "discovered something unusual: a bright flash of optical light lasting for a few hours. Searching further, we found several similar signals," said Nathalie Degenaar, co-author of the paper recently published in the journal *Nature* (quoted from source).

They spotted three micronovae with this data. Using the European Southern Observatory's Very Large Telescope (VLT) they were able to verify one of the star's status as a white dwarf; the other two were known white dwarfs.

It is unknown how often these micronovae happen. According to Simone Scaringi of Durham University in the UK who is the lead astronomer for the team, "One of the systems shows evidence for micronovae recurring about every 100 days or so. Another target shows the bursts happening about every day on the other hand." The regularity seems to be tied in to the amount of mass the white dwarf collects over a set amount of time. "The faster recurring system has a much higher mass accretion rate than the other system."

Continuing on, Scaringi says "It may be that a specific system will show the (recurring) micronovae events only when the material being funneled on to the magnetic poles can remain confined for long enough to reach thermonuclear triggering conditions. In some occasions this may not happen, and material will (evenly) spread around the entire white dwarf surface, potentially building a layer of fresh hydrogen that may grow over time and drive a classical nova."

""These events may actually be quite common, but because they are so fast they are difficult to catch in action," Scaringi explains" (source). In order to answer these questions the team wants to find more of these micronovae outbursts and are looking forward to using data from large-scale surveys combined with rapid response observations from telescopes like the VLT or ESO's New Technology Telescope.

Prepare Yourself: New Engineering Images from JWST Will Blow Your Mind

If the phrase "My god, it's full of stars" was ever appropriate, it's today, because of these new images from the James Webb Space Telescope. These are 'just' engineering images, mind you, but they are incredible. The number of stars and galaxies visible in each image is just remarkable, not to mention the crisp clarity in the fields of view.

The images were taken by JWST after the completion of the process to fully focus the telescope's mirror segments. Now the team will begin commissioning the four science instruments, a process that will take about two months to complete. This is the final phase before the observatory will be fully ready to begin its science observations.

In analyzing these new images, the team says the optical performance is better than "the most optimistic predictions."

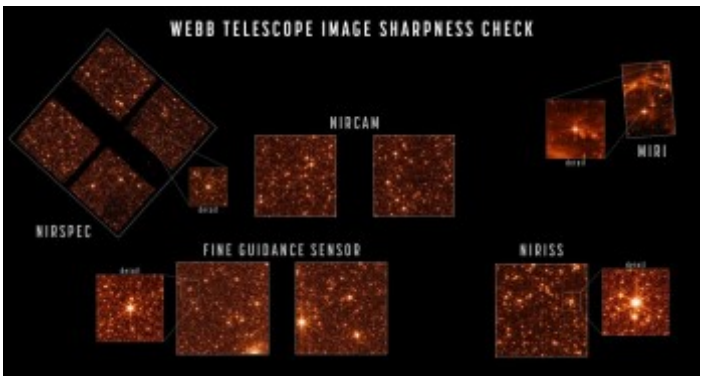
"These remarkable test images from a successfully aligned telescope demonstrate what people across countries and continents can achieve when there is a bold scientific vision to explore the universe," said Lee Feinberg, Webb optical telescope element manager at NASA's Goddard Space Flight Center.

The alignment of the telescope's 18 mirror segments means the mirrors are now directing fully focused light down into each instrument, and each instrument is successfully capturing images with the light being delivered to them. The teams said the image quality delivered to all instruments is "diffraction-limited," meaning that the "fineness of detail that can be seen is as good as physically possible given the size of the telescope."

The depth quality of these images is just a taste of what's to come with JWST. Each image is like its own "Deep Field," – showing innumerable stars and galaxies – like the famous Hubble Deep Field images, but even deeper.

"These images have profoundly changed the way I see the universe," said Scott Acton, Webb wavefront sensing and controls scientist at Ball Aerospace. "We are surrounded by a symphony of creation; there are galaxies everywhere! It is my hope that everyone in the world can see them."

As in the image below, which shows even more detail of the observations, the sharpness and clarity remains even when you zoom in. NASA explains the images:



Engineering images of sharply focused stars in the field of view of each instrument demonstrate that the telescope is fully aligned and in focus. For this test, Webb pointed at part of the Large Magellanic Cloud, a small satellite galaxy of the Milky Way, providing a dense field of hundreds of thousands of stars across all the observatory's sensors. The sizes and positions of the images shown here depict the relative arrangement of each of Webb's instruments in the telescope's focal plane, each pointing at a slightly offset part of the sky relative to one another. Webb's three imaging instruments are NIRCam (images shown here at a wavelength of 2 microns), NIRISS (image shown here at 1.5 microns), and MIRI (shown at 7.7 microns, a longer wavelength revealing emission from interstellar clouds as well as starlight). NIRSpec is a spectrograph rather than imager but can take images, such as the 1.1 micron image shown here, for calibrations and target acquisition. The dark regions visible in parts of the NIRSpec data are due to structures of its microshutter array, which has several hundred thousand controllable shutters that can be opened or shut to select which light is sent into the spectrograph. Lastly, Webb's Fine Guidance Sensor tracks guide stars to point the observatory accurately and precisely; its two sensors are not generally used for scientific imaging but can take calibration images such as those shown here. This image data is used not just to assess image sharpness but also to precisely measure and calibrate subtle image distortions and alignments between sensors as part of Webb's overall instrument calibration process. Credit: NASA/ STScI

While the mirror is now fully in focus, engineers will still need to make small periodic adjustments to the mirror segments during the lifetime of the mission. Even small changes in temperature or movements of the spacecraft can alter the alignment.

"Our plan is check the alignment every two weeks," Feinberg told me earlier this year. "But we will take data roughly every two days, and look at it. So, we have the ability to do it even more frequently, but it may be that we'll find we don't need to do it every 2 weeks. This is one of the things we are interested to learn — is how frequently we'll have to update the mirror."

You can keep track of JWST's instrument commissioning phase at the Where's Webb site.

Amazing! Ingenuity Helicopter Flies to the Perseverance Backshell and Parachute to See Them Close Up

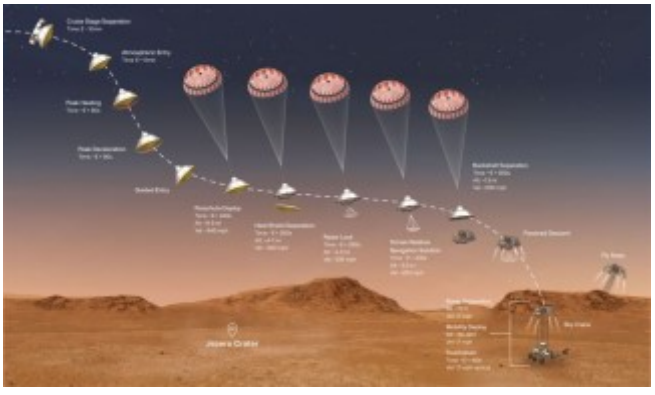
You may recall we reported earlier this month that the Perseverance rover finally spotted its parachute and backshell off in the distance. This is the hardware that safely brought the rover to Mars surface on February 18, 2021.

But now, the incredible Ingenuity helicopter has snapped better images of those items, while it was hovering in the Martian air during its 26th flight.

And what a mess! The poor backshell crashed to the surface, splitting into pieces.

This image of Perseverance's backshell (left of center), supersonic parachute (far right), was collected from an altitude of 26 feet (8 meters) by NASA's Ingenuity Mars Helicopter during its 26th flight on Mars on April 19, 2022. Credit: NASA/JPL/Caltech

NASA said the backshell, the white, shattered flying-saucer looking piece of equipment, would have impacted the surface at about 126 kph/78 mph – which was the plan all along. Also visible in the photos are the parachute, along with the 80 high-strength suspension lines connecting the backshell to the parachute. This parachute was the biggest ever deployed on Mars (Perseverance is the largest rover to date). The orange-and-white parachute dimensions are 21.5 meters (70.5 feet) wide.



***Perseverance Rover's Entry, Descent and Landing Profile**: This illustration shows the events that occur in the final minutes of the nearly seven-month journey that NASA's Perseverance rover took to Mars. Credit: NASA/JPL-Caltech.*

These items were essential to bring Perseverance safely to the surface, as part of the entry, descent, and landing (EDL) on Mars – otherwise known as the 7 Minutes of Terror. During those seven minutes, the incoming spacecraft carrying the rover comes screaming into Mars atmosphere at nearly 20,000 kph (12,500 mph) experiencing extreme gravitational forces and high temperatures. Through atmospheric resistance (and using small thrusters to keep the lander on target), the heat shield-covered backshell slows the spacecraft to under 1,600 kph (1,000 mph). At that point, it's safe to deploy the supersonic parachute. The parachute slows the lander enough to where the backshell and parachute are

jettisoned, (about 2.1 km 1.3 miles in altitude), allowing a hovering rocket stage called the Sky Crane to gently lower the rover to the surface.

Those seven minutes are fast-paced and stressful, because it all has to happen automatically, with no input from engineers back on Earth.

NASA engineers love to see these items – even in their crashed state – because it can inform them on how well these pieces of hardware worked, providing valuable insights for future missions. Ingenuity's 26th flight on April 19, 2022 provides the perspective engineers were hoping for. In total, Ingenuity took 10 aerial images of the debris field.

One of the upcoming planned missions that will benefit the most from these images is the future Mars Sample Return Lander, which is part of a multimission campaign that would bring Perseverance's samples of Martian rocks, atmosphere, and sediment back to Earth for detailed analysis. Engineers for this mission actually made a request to the Ingenuity team for these images.

"NASA extended Ingenuity flight operations to perform pioneering flights such as this," said Teddy Tzanetos, Ingenuity's team lead at NASA's Jet Propulsion Laboratory, in a press release. "Every time we're airborne, Ingenuity covers new ground and offers a perspective no previous planetary mission could achieve. Mars Sample Return's reconnaissance request is a perfect example of the utility of aerial platforms on Mars."

A picture of the Ingenuity helicopter on the surface of Mars, taken by the Perseverance rover. Credit: NASA/JPL/Caltech

NASA said several weeks of analysis will be needed for a final verdict.

"Perseverance had the best-documented Mars landing in history, with cameras showing everything from parachute inflation to touchdown," said JPL's Ian Clark, former Perseverance systems engineer and now Mars Sample Return ascent phase lead. "But Ingenuity's images offer a different vantage point. If they either reinforce that our systems worked as we think they worked or provide even one dataset of engineering information we can use for Mars Sample Return planning, it will be amazing. And if not, the pictures are still phenomenal and inspiring."

Perseverance Begins the Next Phase of its Mission, Studying an Ancient River Bed on Mars

On February 18, 2021, NASA's Perseverance (Percy) Rover successfully landed in the dried-up lakebed known as Jezero Crater on Mars, beaming back images and video of its descent and landing to millions of space fans living on the planet that built and launched this incredible robotic explorer. With this landing came enormous excitement for a new era of robotic exploration of the Red Planet as we slowly continue to unlock the secrets of Mars and its ancient past, to include (hopefully) finding evidence of past life.

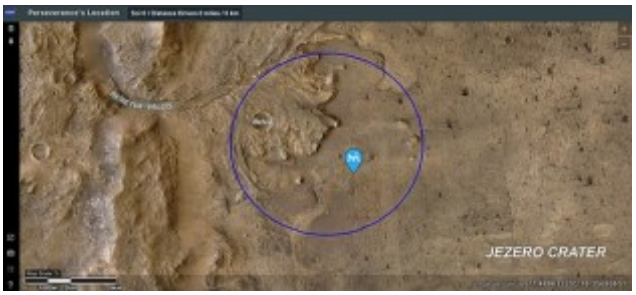
This high-resolution still image is part of a video taken by several cameras as NASA's Perseverance rover touched down on Mars on Feb. 18, 2021. A camera aboard the descent stage captured this shot. (Credit: NASA JPL)

While Mars *might* have once featured a lush and habitable environment, today it's nothing more than a cold, dead world. With an average surface temperature of -63°C (-82°F) and an atmosphere consisting of 95% carbon dioxide and pressures that are 100 times less than Earth's, the Mars of today is incredibly inhospitable for life as we know it here on our blue marble in space. This extremely harsh environment hasn't stopped us from trying to unlock Mars' secrets and learn more about how it came to be what it is today, with Percy working literally tirelessly to continue this incredible scientific journey.

During its venture on Mars, Percy collected eight rock-core samples during its first science campaign and completed a record-breaking 31-Martian-day (sol) trek across 5 kilometers (3 miles) of Mars. It ultimately arrived at the doorstep of Jezero's ancient river delta on April 13, 2022. This delta is significant as it will not only serve as Percy's staging area for its second science campaign, known as the "Delta Front Campaign", but is also believed to be the mission's best bet in finding preserved remnants of ancient microbial life.

The delta, a massive fan-shaped collection of rocks and sediment at the western edge of Jezero Crater, formed at the convergence of a Martian river and a crater lake billions of years ago. Its exploration tops the Perseverance science team's wish list because all the fine-grained sediment deposited at its base long ago is the mission's best bet for finding the preserved remnants of ancient microbial life.

"We've been eyeing the delta from a distance for more than a year while we explored the crater floor," said Ken Farley, Perseverance project scientist at Caltech in Pasadena. "At the end of our fast traverse, we are finally able to get close to it, obtaining images of ever-greater detail revealing where we can best explore these important rocks." Having officially kicked off on April 18, 2022, the Delta Front Campaign will instruct Percy to drive to the southwest and then to the west. The goal of this first leg will be to scout the best route to ascend the delta, which rises about 40 meters (130 feet) above the crater floor.



Map showing Perseverance's landing site at the Jezero Crater on Mars. (Credit: NASA)

The Delta Front Campaign is scheduled to take about half an Earth year, during which time Percy will be conducting detailed science investigations while on the way up the delta, and on the way back down, as well. These investigations include taking rock core samples, and Percy is expected to collect around eight samples during this time.

"The delta is why Perseverance was sent to Jezero Crater: It has so many interesting features," said Farley. "We will look for signs of ancient life in the rocks at the base of the delta, rocks that we think were once mud on the bottom of 'Lake Jezero.' Higher up the delta, we can look at sand and rock fragments that came from upstream, perhaps from miles away. These are locations the rover will never visit. We can take advantage of an ancient Martian river that brought the planet's geological secrets to us."

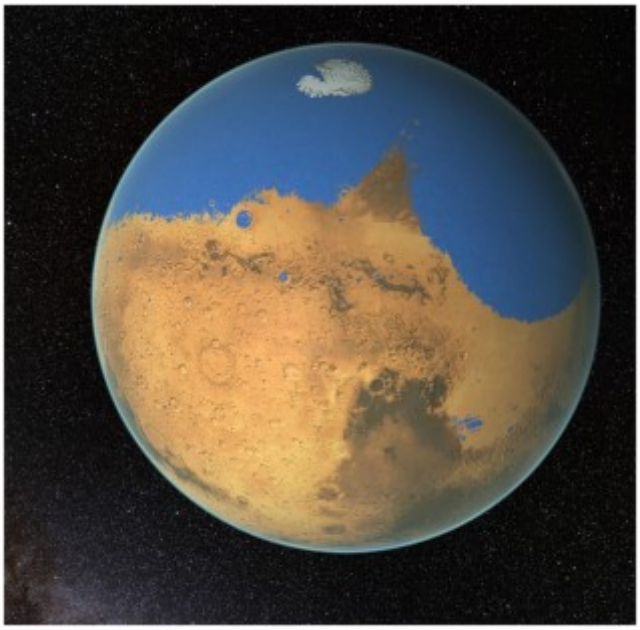
Jezero Crater

As stated, Jezero Crater on Mars is a dried-up lakebed believed to once be the home of a massive amount of liquid water deep in Mars' ancient past. The crater itself has a diameter of 45 kilometers (25 miles) and is located in the Syrtis Major quadrangle. Aside from the delta that is located in the western part of Jezero, the crater also displays point bars and inverted channels, other evidence that liquid water once existed there long ago.

Artist's concept of Jezero Crater filled with a lake. (Credit: NASA JPL)

Ancient Past: A Wetter, Warmer Mars

When Mars first formed billions of years ago, its interior was searing with heat and a spinning outer core. This spinning outer core gave Mars a magnetic field, shielding it from the intense cosmic radiation from the Sun. This magnetic field allowed auroras to dance across the night sky in breathtaking fashion, much like what we see near the poles on present-day Earth. This interior heat also fueled the many volcanoes spread across the surface to replenish the atmosphere just like what happens on present-day Earth, giving Mars a much thicker atmosphere and allowing liquid water to cascade across its surface, carving out channels and streams, and even filling many craters also strewn across its vast surface. Alas, with Mars being half the size of Earth, physics intervened, and the Red Planet slowly died from the inside out due to the loss of heat. When you put potatoes in an oven and remove them some time later, the smaller potatoes cool off much faster than the larger ones, and this cooling was the unfortunate fate for Mars. With the loss of heat, the volcanoes ceased to replenish the atmosphere and the magnetic field slowly faded away. Losing these two key atmospheric components caused the once cascading liquid water to slowly evaporate, leaving us with the cold, dead world we see today.



Artist's impression of an ancient, watery Mars. (Credit: NASA/Goddard Space Flight Center)

What secrets will Percy unlock about the ancient past of Mars? How long was liquid present on the surface, and will this car-sized rover find evidence of past life on the Red Planet? Time will tell, and this is why we science!

As always, keep doing science & keep looking up!

Source: NASA JPL

Lead image: The expanse of Jezero Crater's river delta is shown in this panorama of 64 stitched-together images taken by the Mastcam-Z system on NASA's Perseverance Mars rover on April 11, 2022, the 406th Martian day, or sol, of the mission. (Credit: NASA/JPL-Caltech/Arizona State University/Malin Space Science Systems)

Astronomy Jargon 101: Sunspots

In this series we are exploring the weird and wonderful world of astronomy jargon! You'll feel a little cooler after reading about today's topic: sunspots!

Sunspots are regions on the surface of the Sun that appear darker than the surrounding area. They are caused by the Sun's massive magnetic field bundling up and punching through the surface. sunspots tend to come and go following an 11-year cycle that tracks the Sun's magnetic activity.

Astronomers since ancient times have known about sunspots, though they were difficult to observe before the invention of the telescope. Galileo Galilei made many observations of them, and used their motion to prove that the Sun was rotating.

A single sunspot lasts anywhere from a few days to a handful of months. But they rarely come alone, almost always appearing in groups. A group on one half (either north or south of the equator) of the Sun will usually find a matching group on the opposite side. These groups will last up to a few months. After a few years of intense sunspot activity, they will start to dwindle. Sometimes the Sun remains free of blemishes for years before they appear again.

For centuries astronomers have recorded a regular 11-year pattern to the disappearance and resurgence of sunspots. Through careful observation, measurement, and laboratory experiments, astrophysicists have determined that the activity of these spots is connected to the Sun's magnetic field. When the magnetic field is weak and untangled, few spots appear. Over time, the Sun's rotation tangles up the magnetic field lines, causing them to burst out of the surface, like worms popping out of a rotten apple. The spots appear where the field lines exist and reenter the surface.

Sunspots appear darker because they are cooler than the surrounding surface, typically by a few thousand Kelvin. The strong magnetic fields at the location the spots prevent the normal cycles of heat convection near the surface, causing the cooling effect.

Other stars also host spots of their own, in which case astronomers call them *starspots*.

Chinese Astronomers Recorded Earliest Account of Aurora

How dating an ancient text revealed one of the oldest observations of aurora known.

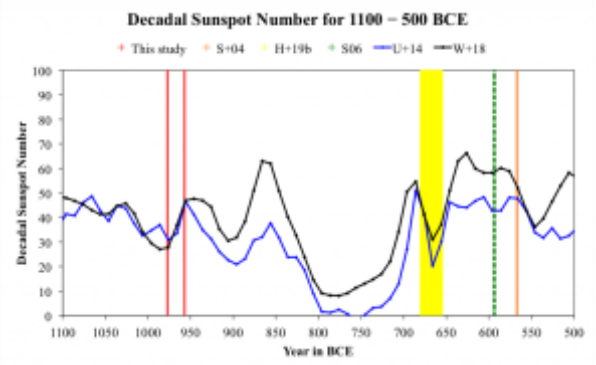
It's one of the greatest sky spectacles you can witness. Along with a total solar eclipse and a major meteor storm, I'd put a fine aurora display up there as one of the the most amazing things you can see in the night sky. And we're not talking about the dull green glow that folks in the 'lower 48' see to the north and dismiss, but the glorious silent streamers of auroral curtains that can light up the entire sky.

Now, a recent study, entitled *A Candidate Auroral Report in the Bamboo Annals Indicating a Possible Extreme Space Weather Event in the 10th Century BCE* may have pinpointed one of the earliest accounts on ancient aurorae. In the study, University of Pennsylvania and Nagoya University researchers culled through the legendary chronicle known as the *Bamboo Annals* (also sometimes referred to as *Zhushu Jinian*) penned around the 4th century BCE. Chinese texts are some of the best documented sources of sky phenomena stretching back over the millennia, to include accounts of naked eye sunspots, supernovae and meteor outbursts.

A section from the *Bamboo Annals*. Credit: Nagoya University.

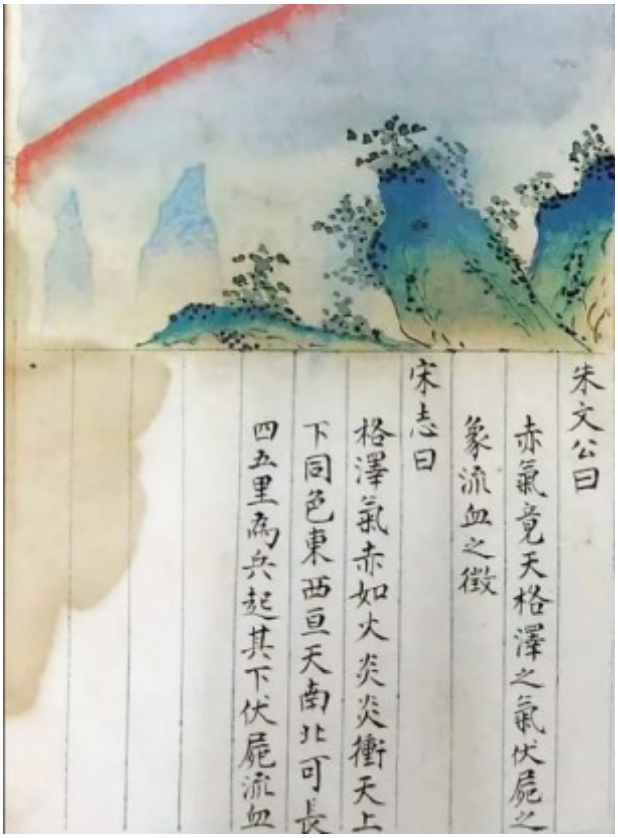
Specifically, the *Annals* refer to a "five-coloured light" in the northern sky, around the time of the Zhou Dynasty. Using the accurate chronology of ancient Chinese dynasties allowed researchers to refine the date for the observations down to between 977 to 957 BCE—a span of only two decades. This would place the aurora observation and account three centuries earlier than any previous known observation.

"The original report was only dated as the last year of King Zhao," says Hisashi Hayakawa (Nagoya University). "We were not sure when it was. However, these scholarly chronologies have allowed us to date the reign (and hence the last year too) of King Zhao. This allows us to date this candidate auroral record."



Averaged decadal sunspot numbers, versus the periods cited in the study. Nagoya University.

Researchers also noted that tree ring data (another source of defining ancient solar activity) suggest that the Sun was especially active and on the uptick in the 10th thru the 8th century before what is known as the Homeric Grand Minimum, and that the drifting magnetic pole and auroral oval would have been tipped towards the Eurasian side of the globe at the time, also favoring Chinese observers.



A 9th century AD Chinese text (*Tianyuan Yuli Xiangyifu*) depicting aurora, from the National Archives of Japan.

"The candidate space weather report indicates probable enhancement of the solar cycle," says Hayakawa. "Mid-latitude aurorae are typically seen in active phases of the solar cycles."

The study is important as it shows how ancient records can be tied with scientific observations.

An aurora timelapse. Credit: Mary McIntyre.

Auroral displays must have been a true puzzle for ancient skywatchers. And to think, they would have had no idea as to *what* they were actually seeing. The topic of aurora is also timely in terms of modern space weather, as Solar Cycle 25 gets underway in earnest in 2022. Just this past weekend, we now have a massive sunspot complex turning Earthward:

Keep an eye out for aurora from mid-to high latitudes, and stare in wonder at a spectacle that must have awed Chinese astronomers long ago, and moved them enough to write it down.

Wow! Perseverance Sees a Solar Eclipse on Mars

Imagine standing on Mars, and seeing this with your own eyes.

The Perseverance rover watched as the potato-shaped moon Phobos passed in front of the Sun, from the vantage point of Jezero Crater on Mars. Perseverance used its high-resolution Mastcam-Z camera system to shoot video of Phobos, and NASA says the result is the most zoomed-in, highest frame-rate observation of a Phobos solar eclipse ever taken from the Martian surface.

The stunning eclipse took place on April 2, 2022 (Earth date, of course) and the eclipse lasted a little over 40 seconds. That means this video is very close to what Perseverance witnessed in real time. The time it takes for Phobos eclipse the Sun is much less time than a typical solar eclipse involving Earth's Moon, since Phobos is about 157 times smaller than our own Moon. The Mastcam-Z has special solar filters that allow it to stare directly at the Sun. The video is of such high resolution, that even sunspots are visible on the Sun.

Scientists say that each time these eclipses are observed, it allow them to measure subtle shifts in Phobos' orbit over time. The moon's tidal forces pull on the deep interior of the Red Planet, as well as its crust and mantle, and so studying how much Phobos shifts over time reveals something about how resistant the crust and mantle are, and thus what kinds of materials they're made of.

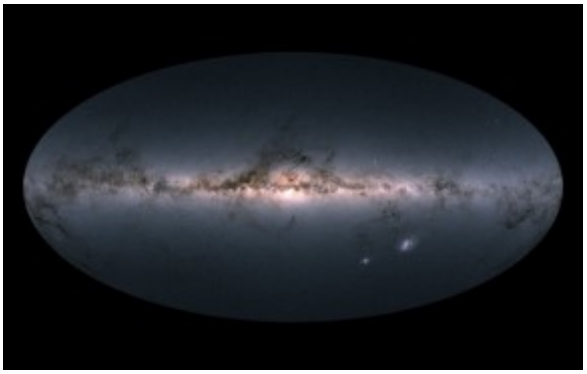
All I know is, this is incredibly awe-inspiring.

The Milky Way has an Inner Ring, Just Outside the Core

In the past century, astronomers have learned a great deal about the cosmos and our place in it. From discovering that the Universe is in a constant state of expansion to the discovery of the Cosmic Microwave Background (CMB) and the Big Bang cosmological model, our perception of the cosmos has expanded immensely. And yet, many of the most profound astronomical discoveries still occur within our cosmic backyard – the Milky Way Galaxy.

Compared to other galaxies, which astronomers can resolve with relative ease, the structure and size of the Milky Way have been the subject of ongoing discovery. The most recent comes from the Max Planck Institute for Extraterrestrial Physics (MPE), where scientists have found a previously undiscovered inner ring of metal-rich stars just outside the Galactic Bar. The existence of this ring has revealed new insights into star formation in this region of the galaxy during its early history.

Determining the structure and size of the Milky Way galaxy has always been marred by the fact that we are situated within the Milky Way's galactic disk, close to one of its spiral arms. From this vantage point, stars are obscured by dense clouds of gas and dust, especially towards the center of the Milky Way. This has made it particularly difficult to determine the structure of the inner Milky Way.



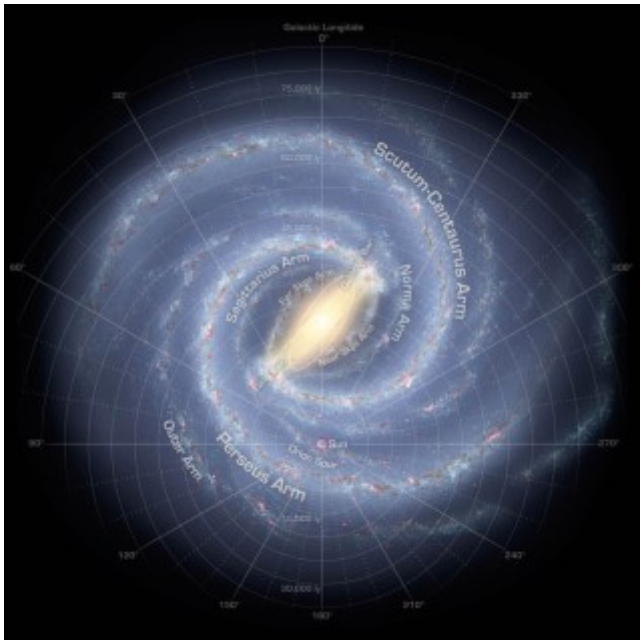
Using information from Gaia's second data release, a team of scientists has made refined estimates of the Milky Way's mass. Credit: ESA/Gaia/DPAC

One enduring mystery about our galaxy is whether or not it had any star-forming inner rings, which have been seen in other disk galaxies. Luckily, scientists at the MPE spent the past decade combining data from various observation campaigns – including the APOGEE survey and the *Gaia Observatory* – with advanced computer simulations. The result was a state-of-the-art model of the inner Milky Way that revealed a slow bar with a peanut-shaped bulge. This bulge is populated by stars that formed four to nine billion years ago, with a peak in age between six and eight billion years.

The APOGEE survey is a large-scale, stellar spectroscopic campaign conducted by the Sloan Digital Sky Survey (SDSS), located at the Apache Point Observatory in New Mexico. This survey was conducted at near-infrared wavelengths, which allows for observations that would not be possible in optical light. In particular, APOGEE's IR observations allow it to see through the dusty regions of the Milky Way, such as the disk and the bulge.

This allowed the MPE team to determine the element abundances, positions, line-of-sight velocities, and approximate ages of all the stars in the newly-observed bulge. Meanwhile, the data obtained by the ESA's *Gaia* mission provided accurate measurements of the positions and proper motions of these stars. The team then combined all of these observations with a model they created of the workings of the inner Milky Way. As Shola M. Wylie, a Ph.D. student at MPE and lead author of the study, explained:

"We integrated more than 30 000 stars from the APOGEE survey with additional data from Gaia in our Milky Way bar-bulge potential to obtain the full orbits of these stars. And with these orbits, we can effectively see behind the galactic bulge as well as other spatial regions not covered by the surveys. Around the central bar, we found an inner ring structure that is more metal-rich than the bar and where the stars have younger ages, around 7 billion years."



Annotated diagram of the Milky Way. The sun is indicated near the bottom in the Orion Spur. Credit: NASA

To separate the stars in the ring and the bar structures, the team observed how much their orbits deviated from a circle (i.e., their eccentricity). From this, they found that the stars in the ring are younger and more metal-rich than the stars in the bar and are more concentrated towards the Galactic plane. This suggests that stars in the stellar ring must have continued to form from inflowing gas after the bar was in place.

Therefore, astronomers can use the age of the inner ring stars to look back at the formation history of the Milky Way. Based on the average age of the stars, the MPE team estimates that the Galatic bar formed at least 7 billion years ago. At present, it's not clear if there is a connection between the newly discovered inner ring and the galaxy's spiral arms and whether gas is currently funneled inwards to a star-forming thin inner ring, as is seen with other spiral galaxies.

With next-generation telescopes becoming operational, more detailed galactic surveys will be possible. When combined with augmented models (which will be possible using more sophisticated software), this data will allow astronomers to learn more about how the ring structure transitions to the surrounding disk in the Milky Way. The study that describes their findings, titled "The Milky Way's middle-aged inner ring," recently appeared in the journal *Astronomy & Astrophysics*.

E Mails Viewings Logs and Images from Members.

Hi Andy,
Here is my viewing log submission for the WAS May 2022 Newsletter.

In mid-March I went on a last minute cruise to Norway in the hope of viewing the Aurora Borealis. Initial conditions were not good with sea fog, snow, icy decks, high winds etc. Well, it was the North Sea in winter! However, on 28th March we crossed the Arctic Circle. That evening in the Norwegian Sea the sky cleared and I could see the Aurora so I went to my cabin to grab my camera gear. On my return passengers were coming back inside saying the display was finished. I went out on deck anyway and about five minutes later the sky exploded with Aurora! The display lasted about an hour. The first image is from that display although a ship is not a stable platform hence the wiggly stars.

On 30th March I went on an evening tour to a site 50km south of Alta, Norway. When we left the ship the sky was cloudy and no stars were visible. As we were travelling to the site conditions did not seem to be improving. But when we arrived there was clear sky and the Aurora appeared almost as we got off the coach. There was deep snow at the site - my tripod disappeared in a snow drift when I tried to set up at one location. The display was brilliant with Aurora all over

the sky for almost two hours. I did not know which direction to point the camera as there was so much activity. In the end I was frozen as was the camera – it was -7 degrees Centigrade! I was glad of the log fires in the cabin and hot coffee. I have attached three images from this display.

Finally in Tromso on 1st April I went on what I would call an extreme search for the Aurora. I thought the conditions were so bad in the evening that the tour would be cancelled as there was very deep snow and snow was still falling heavily. If we were in the UK I don't think we would have got out of the car park. The guide was confident that if we found clear sky we would see the Aurora. So the aim was to find clear sky when there were blizzard conditions! After driving for an hour the driver stopped the van to clear the windscreen of snow and ice. Again, I thought we would return to the ship but we carried on for another hour! We eventually pulled into a layby about 90km from Tromso and waited as the guide's weather app showed the sky clearing at that location. After another hour or so stars appeared and the Aurora. It was not as good a display as previous evenings but from the organisers point of view we did see the Aurora. Also, it was the last tour of the season because sunset was getting later and later each day. In all the tour lasted seven hours and was a 180km round trip in a blizzard! A bit extreme!

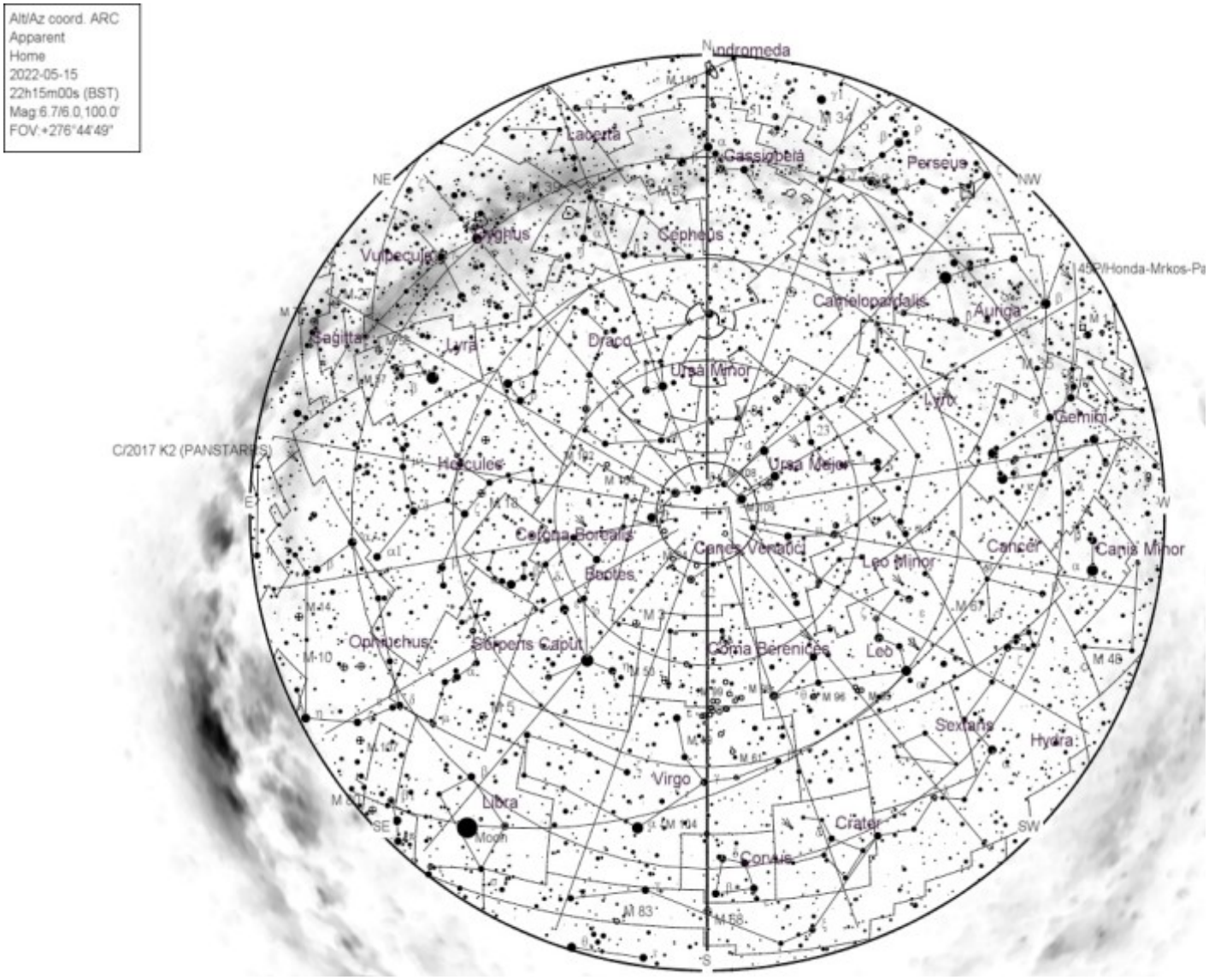
Overall, it was a successful trip to see the Aurora Borealis with overnight stays in Alta and Tromso. A good last minute decision to go on the cruise!

All images Canon 6D Mk 1, Sigma 20mm F1.8 at F1.8, ISO 800, 10 Sec.

Clear Skies,

John

WHATS UP, MAY 2022

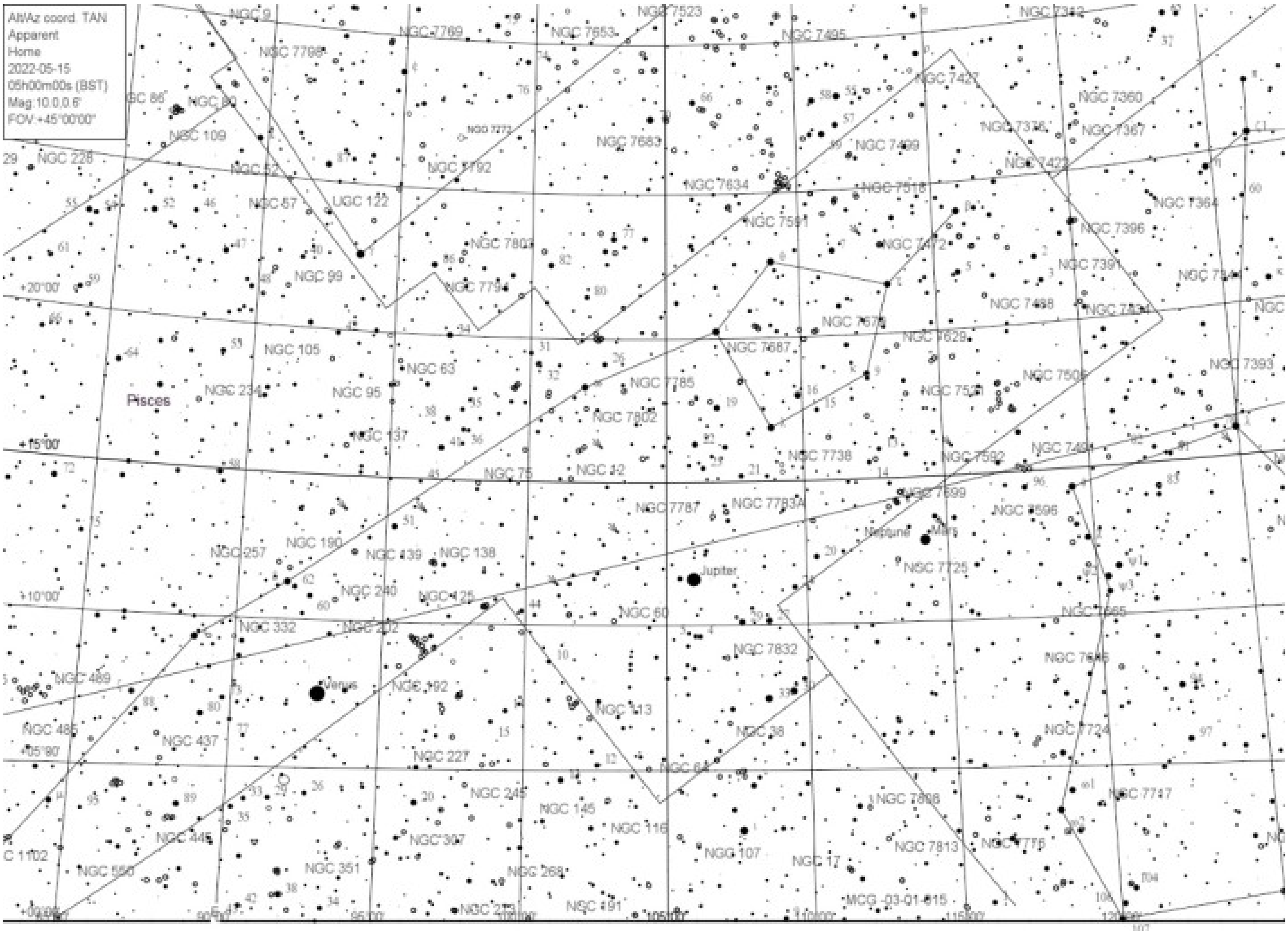


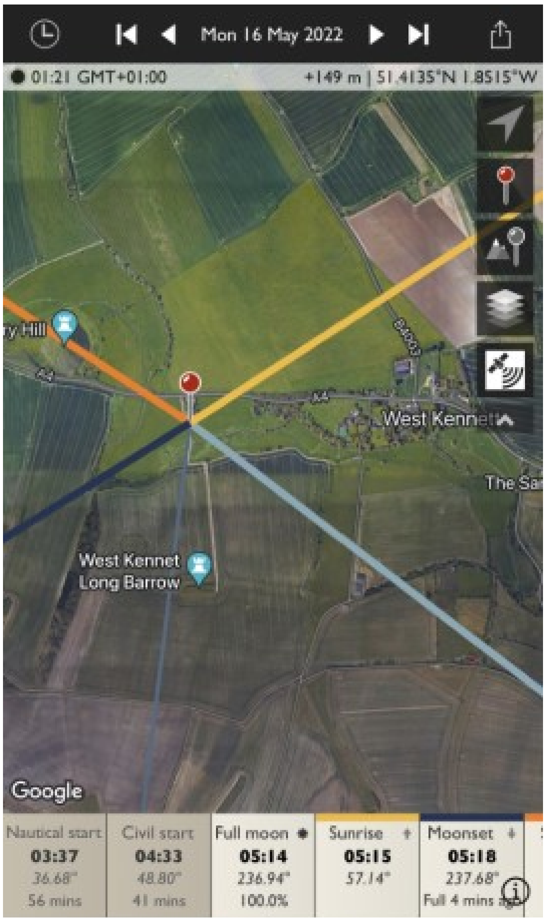
May 6, 7 - **Eta Aquarids Meteor Shower.** The Eta Aquarids is an above average shower, capable of producing up to 60 meteors per hour at its peak. Most of the activity is seen in the Southern Hemisphere. In the Northern Hemisphere, the rate can reach about 30 meteors per hour. It is produced by dust particles left behind by comet Halley, which has been observed since ancient times. The shower runs annually from April 19 to May 28. It peaks this year on the night of May 6 and the morning of the May 7. The waxing crescent moon will set early in the evening, leaving dark skies for what should be an excellent show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.

May 16 - **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 04:15 UTC. This full moon was known by early Native American tribes as the Flower Moon because this was the time of year when spring flowers appeared in abundance. This moon has also been known as the Corn Planting Moon and the Milk Moon.

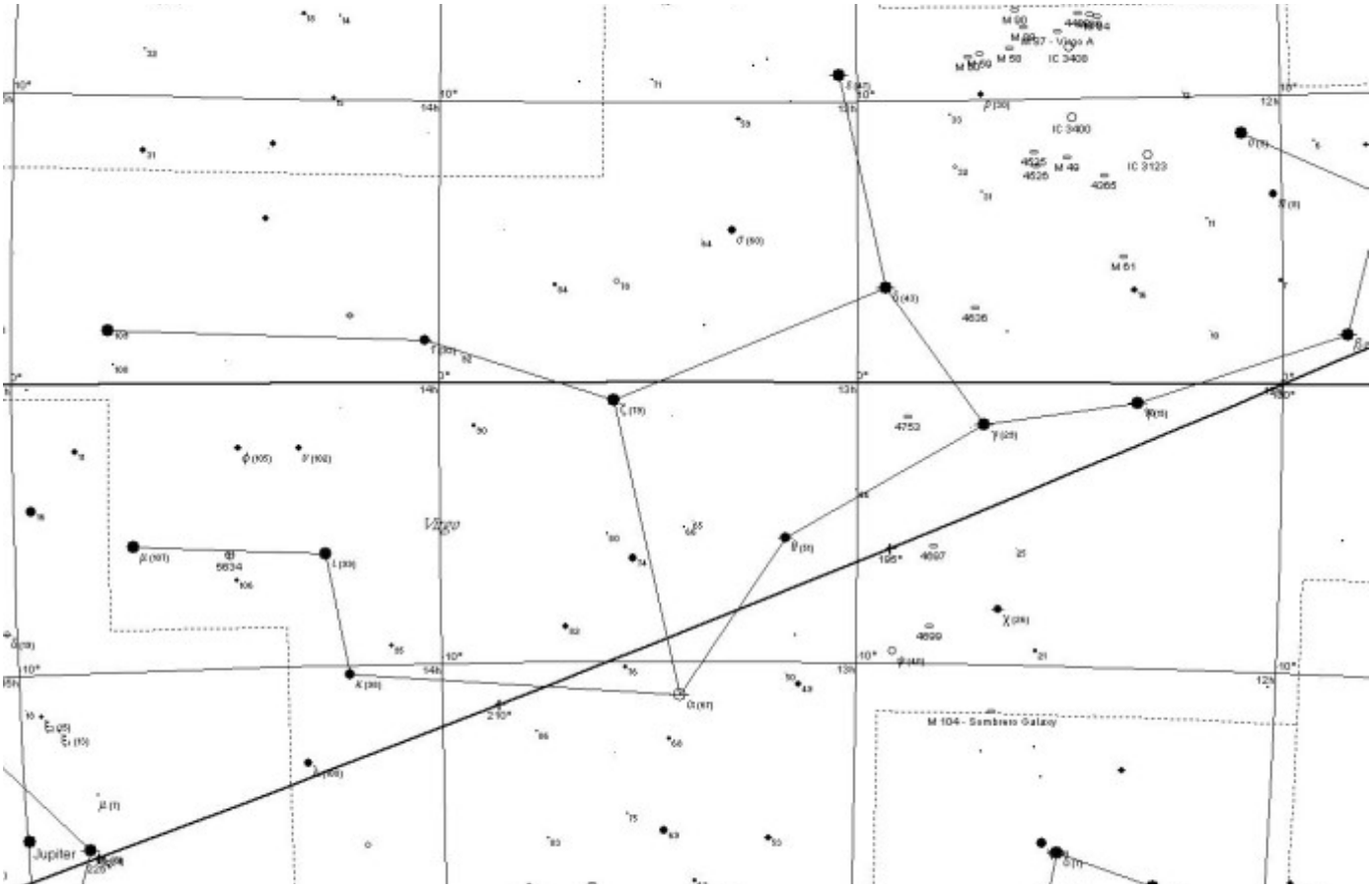
May 16 - **Total Lunar Eclipse.** A total lunar eclipse occurs when the Moon passes completely through the Earth's dark shadow, or umbra. During this type of eclipse, the Moon will gradually get darker and then take on a rusty or blood red color. The eclipse will be visible throughout all of North America, Greenland, the Atlantic Ocean, and parts of western Europe and western Africa. (**NASA Map and Eclipse Information**)

May 30 - **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 11:32 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.


Alt/Az coord. TAN
Apparent
Home
2022-05-15
05h00m00s (BST)
Mag:10.0,0.6'
FOV:+45°00'00"
Pisces
Venus
Jupiter
Mars
Neptune
+20°00'
+15°00'
+10°00'


Mon 16 May 2022
01:21 GMT+01:00
+149 m | 51.4135°N 1.8515°W
West Kennett
West Kennet Long Barrow
A4
Google
Nautical start 03:37 36.68° 56 mins
Civil start 04:33 48.80° 41 mins
Full moon 05:14 236.94° 100.0%
Sunrise 05:15 57.14°
Moonset 05:18 237.68° Full 4 mins ago

CONSTELLATIONS OF THE MONTH: VIRGO



Virgo

As one of the zodiacal signs, Virgo resides directly on the ecliptic plane and was one of the original 48 constellations charted by Ptolemy. It spans 1294 degrees and is the second largest constellation in the sky. Virgo also contains the point where the celestial equator crosses the ecliptic plane – the the autumn equinox. Between 9 and 15 stars make up its asterism and it contains 96 Bayer Flamsteed designated stars within its confines. Virgo is bordered by the constellations of Bootes, Coma Berenices, Leo, Crater, Corvus, Hydra, Libra and Serpens Caput. It is visible to all observers located at latitudes between +80° and ?80° and is best seen at culmination during the month of May.

There are two annual meteor showers associated with constellation Virgo. The Virginids peak on or about April 10th of each year and will appear to come from a point in the sky near Gamma. This is a relatively active and predictable meteor shower and you can expect to see about 10 meteors per hour on the average during a dark night from a dark location. The second is the Mu Virginids, which peak on or about April 25th. This is also a fairly reliable meteor shower and you can expect to see 7 to 10 meteors per hour on the average coming from an area near the Virgo/Leo border.

In mythology, Virgo is meant to represent the “Virgin”, but who exactly this woman is has never been established – only that she plays an important cultural role. Virgo is often portrayed carrying two sheaves of wheat, one of which is marked by the bright star Alpha – Spica – and it is the only astrological sign represented by a female. Perhaps she is Astraea, the virgin daughter of Zeus who was known as the goddess of justice. After all, Libra, the scales of justice is nearby!

Let’s begin our tour of Virgo with its brightest star – Alpha – the “a” symbol on our map. Alpha Viriginis is best known as Spica. Located 262 light-years away from Earth, 1.0 magnitude Spica glows with the combined light of four unresolved stars and has a visual luminosity 2100 times that of the Sun. As a rotating ellipsoidal variable, the four stars cause complex changes in luminosity by distorting the shape of the brightest components. The dominant star – Spica A – has a mass 11 times that of the Sun and fluctuates in physical size as it varies in brightness. The primary star is at maximum when smallest, giving it the highest photospheric surface temperature. Spica B has a mass of 7 suns. As a spectral type B, these two components produce more light in ultraviolet due to exceedingly high surface temperatures. Spica has two distant telescopic companions – magnitude 12 to the north-northeast, and magnitude 10.5 to the east-northeast.

Now head towards Beta – the “B”. Named Zavijava (sounds like something you’d get at Starbuck’s doesn’t it?) and located about 36 light years away from our solar system, this star holds a very special place in history because of its position in the sky. Since it is so near the ecliptic plane, it can frequently be occulted by the Moon, occasionally a planet, and even the Sun. In Zavijava’s case, it had the honor of being the star Einstein used during the solar eclipse of September 21, 1922 to determine the speed of light in space! What’s more, according to studies, Beta Virginis could host two or three Jupiter-sized planets – either brown dwarf stars in wide orbits or true planetary objects.

Ready for Gamma Virginis? That’s the “Y” symbol. Best known as Porrima, this binary star of nearly matched magnitudes was an easy object for amateur astronomers, but now the smaller apparent distance between the stars requires a larger telescope. Because of its relatively quick orbital period of 168.93 years, you’ll sometimes hear Porrima referred to as the “Shrinking Star”. At the time of this writing (early 2009), the pair is only separated by about .04″ and it will be another 11 years before they have moved apart enough again to be easily split

with a small telescope!

Because there are massive amounts of deep sky objects in Virgo, annotating a map would be so cluttered it would be difficult to read. Let us begin first with the chart we have above which highlights the brighter objects in Virgo – ones easily seen with binoculars and small telescopes. Ready to dance?

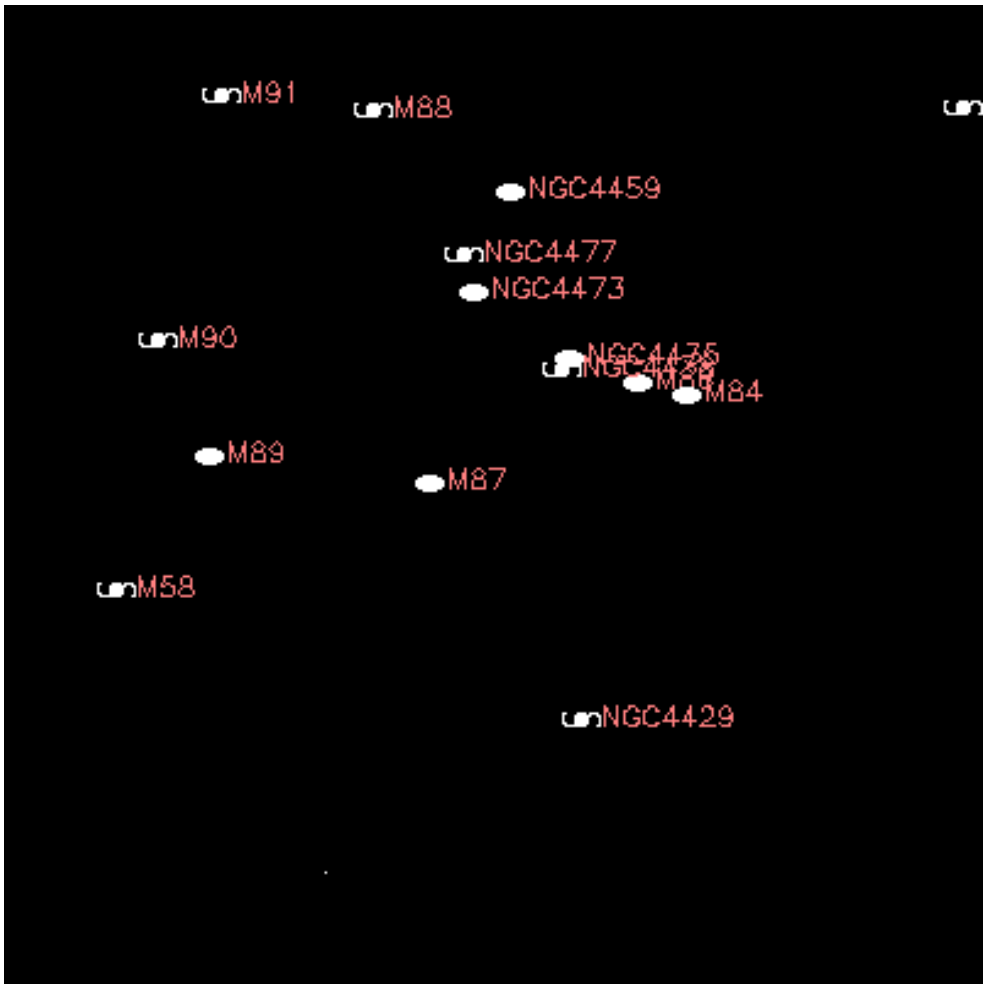
Our first target will be Messier 104 (RA 12 : 40.0 Dec -11 : 37). Now, shake your fist at Spica… Because that's all it takes to find the awesome M104, eleven degrees due west. (If you still have trouble finding M104, don't worry. Try this trick! Look for the upper left hand star in the rectangle of Corvus – Delta. Between Spica and Delta is a diamond-shaped pattern of 5th magnitude stars. Aim your scope or binoculars just above the one furthest south.) Also known as the "Sombrero Galaxy" this gorgeous 8th magnitude spiral galaxy was discovered by Pierre Mechain in 1781, added by hand to Messier's catalog and observed independently by William Herschel as H I.43 – who was probably the first to note its dark inclusion. The Sombrero's rich central bulge is comprised of several hundred globular clusters and can be hinted at in just large binoculars and small telescopes. Large aperture telescopes will revel in this galaxy's "see through" qualities and bold, dark dustlane – making it a seasonal favorite!

Now, let's take a look at one of the brightest members of the Virgo Cluster – Messier 49. Located about eight degrees northwest of Delta Virginis almost directly between a pair of 6th magnitude stars (RA 12 29 46 Dec +07 59 59), the giant elliptical galaxy M49 holds the distinction of being the first galaxy in the Virgo cluster to be discovered – and only the second beyond our local group. At magnitude 8.5, this type E4 galaxy will appear as an evenly illuminated egg shape in almost all scopes, and as a faint patch in binoculars. While a possible supernova event occurred in 1969, don't confuse the foreground star noted by Herschel with something new! Although most telescopes won't be able to pick this region apart, there are also many fainter companions near M49, including NGC 4470. But a sharp-eyed observer named Halton Arp noticed them and listed them as Peculiar Galaxy 134 – one with "fragments!"

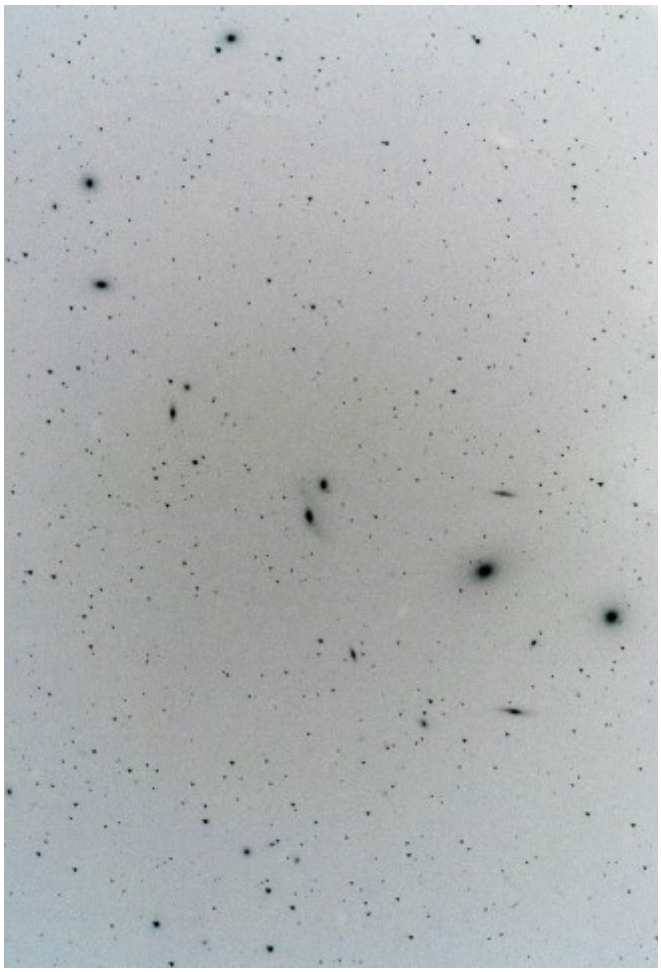
Next up, Messier 87 (RA 12 : 30.8 Dec +12 : 24). It's a radio-source galaxy so bright it can be seen in binoculars – 8.6 magnitude M87, about two fingerwidths northwest of Rho Virginis. This giant elliptical galaxy was discovered by Charles Messier in 1781 and cataloged as M87. Spanning 120,000 light-years, it's an incredibly luminous galaxy containing far more mass and stars than the Milky Way Galaxy – gravitationally distorting its four dwarf satellites galaxies. M87 is known to contain in excess of several thousand globular clusters – up to 150,000 – and far more than our own 200.

In 1918, H. D. Curtis of Lick Observatory discovered something else – M87 has a jet of gaseous material extending from its core and pushing out several thousand light-years into space. This highly perturbed jet exhibits the same polarization as synchrotron radiation – a property of neutron stars. Containing a series of small knots and clouds as observed by Halton Arp at Palomar in 1977, he also discovered a second galaxy jet in 1966 erupting in the opposite direction. Thanks to these two properties, M87 made Arp's "Catalog of Peculiar Galaxies" as number 152. In 1954 Walter Baade and R. Minkowski identified M87 with radio source Virgo A, discovering a weaker galactic halo in 1956. Its position over an x-ray cloud extending through the Virgo cluster make M87 a source of an incredible amount of x-rays. Because of its many strange properties, M87 remains a target of scientific investigation. The Hubble Space Telescope has shown a violent nucleus surrounded by a fast rotating accretion disc, whose gaseous make-up may be part of a huge system of interstellar matter. As of today, only one supernova event has been recorded – yet M87 remains one of the most active and highly prized study galaxies of all. Capture it tonight!

Now we're heading for our more detailed map and the galaxy fields of Virgo about four fingerwidths east-southeast of Beta Leonis. As part of Markarian's Chain, this set of galaxies can all be fitted within the same field of view with a 32mm eyepiece and a 12.5″ scope, but not everyone has the same equipment. Set your sights toward M84 and M86 and let's discover!

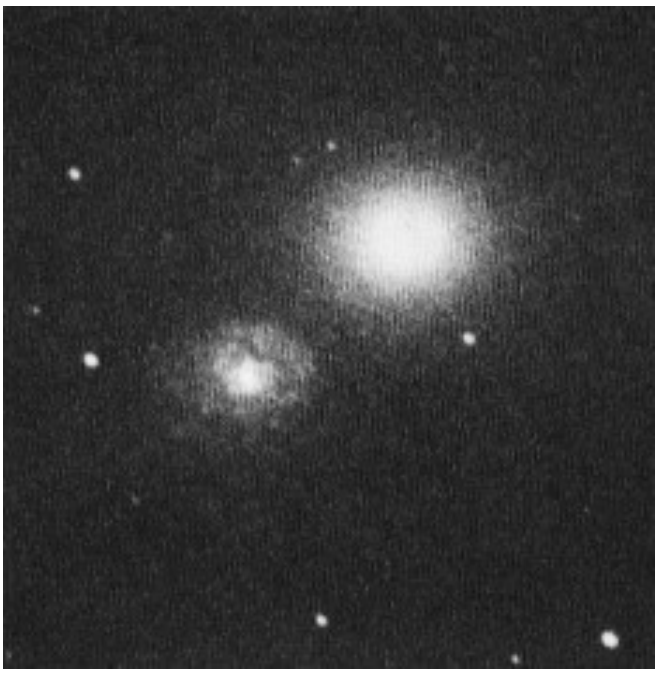


Good binoculars and small telescopes reveal this pair with ease as a matched set of elliptical galaxies. Mid-sized telescopes will note the western member of the pair – M84 – is seen as slightly brighter and visibly smaller. To the east and slightly north is larger M86 – whose nucleus is broader, and less intensely brilliant. In a larger scope, we see the galaxies literally "leap" out of the eyepiece at even the most modest magnifications. Strangely though, additional structure fails to be seen. As aperture increases, one of the most fascinating features of this area becomes apparent. While studying the bright galactic forms of M84/86 with direct vision, aversion begins to welcome many other mysterious strangers into view. Forming an easy triangle with the two Messiers and located about 20 arc-minutes south lies NGC 4388. At mag-



nitude 11.0, this edge-on spiral galaxy has a dim star-like core to mid-sized scopes, but a classic edge-on structure in larger ones.

At magnitude 12, NGC 4387 is located in the center of a triangle formed by the two Messiers and NGC 4388. NGC 4387 is a dim galaxy – hinting at a stellar nucleus to smaller telescopes, while the larger ones will see a very small face-on spiral galaxy with a brighter nucleus. Just a breath north of M86 is an even dimmer patch of nebulosity – NGC 4402 – which needs higher magnifications to be detected in smaller scopes. Large apertures at high power reveal a

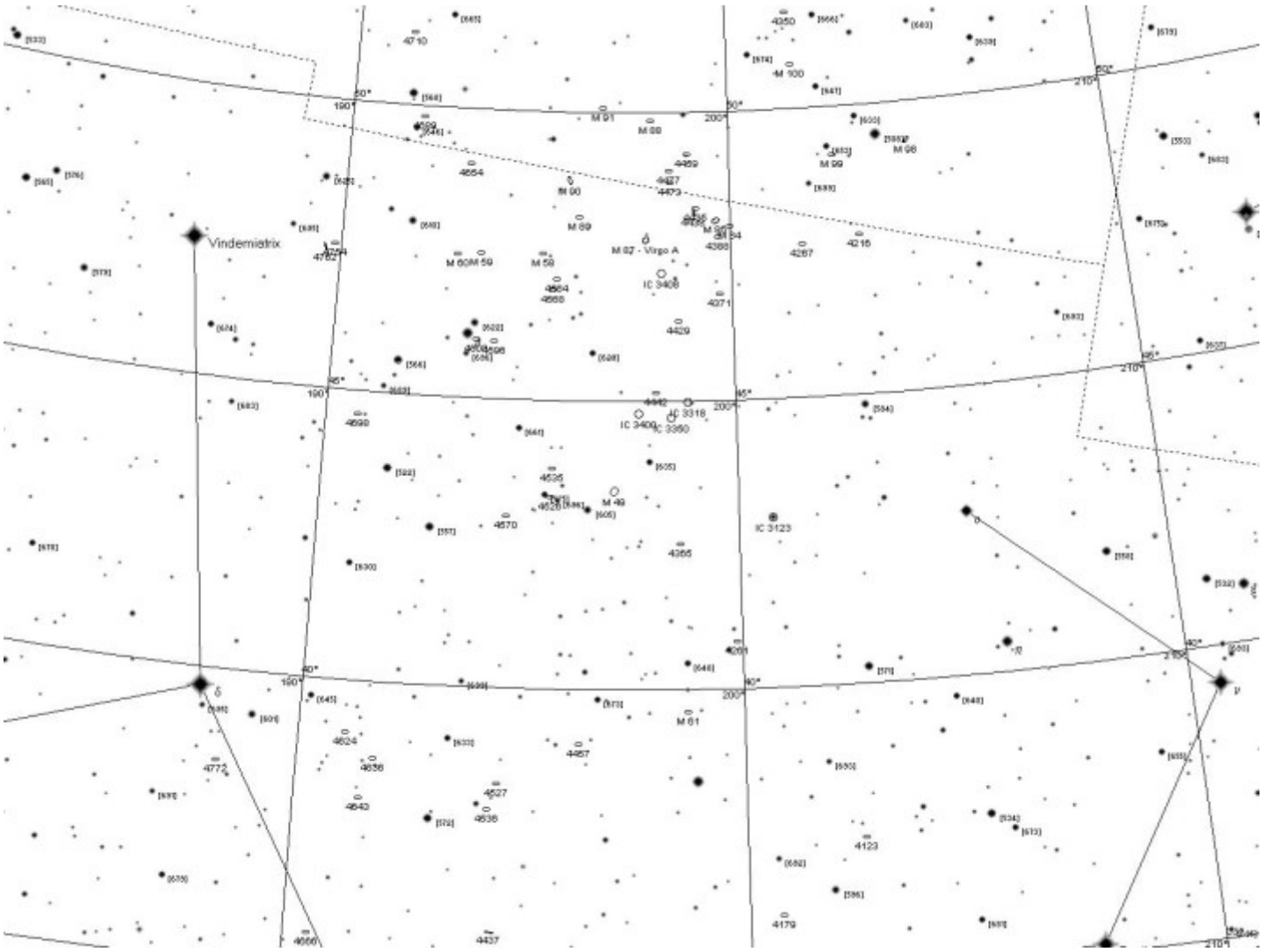


noticeable dust lane. The central structure forms a curved "bar" of light. Luminosity appears evenly distributed end to end, while the dust lane cleanly separates the central bulge of the core. East of M86 are two brighter NGC galaxies – 4435

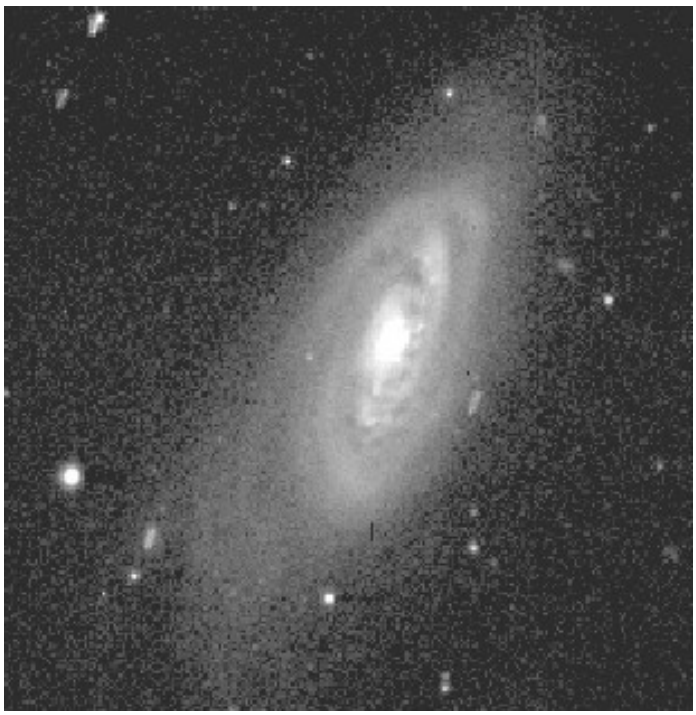
and 4438. Through average scopes, NGC 4435 is easily picked out at low power with a simple star-like core and wispy round body structure. NGC 4438 is dim, but even large apertures make elliptical galaxies a bit boring. The beauty of NGC 4435 and NGC 4438 is simply their proximity to each other. 4435 shows true elliptical structure, evenly illuminated, with a sense of fading toward the edges… But 4438 is quite a different story! This elliptical galaxy is much more elongated. A highly conspicuous wisp of galactic material can be seen stretching back toward the brighter, nearby galaxy pair M84/86.

Ready for bright galaxy Messier 58 (RA 12 : 37.7 Dec +11 : 49)? It's a spiral galaxy actually discovered by Messier in 1779! As one of the brightest galaxies in the Virgo cluster, M58 is one of only four that have barred structure. It was cataloged by Lord Rosse as a spiral in 1850. In binoculars, it will look much like our previously studied ellipticals, but a small telescope under good conditions will pick up the bright nucleus and a faint halo of spiral galaxy structure – while larger ones will see the central concentration of the bar across the core. Chalk up another Messier study for both binoculars and telescopes and let's get on to something really cool!

Around a half degree southwest are NGC 4567 and NGC 4569. L. S. Copeland dubbed them the "Siamese Twins," but this galaxy pair is also considered part of the Virgo cluster. While seen from our viewpoint as touching galaxies, no evidence exists of tidal filaments or distortions in structure, making them a line of sight phenomenon and not interacting members. While that might take little of the excitement away



from the “Twins,” a supernova event has been spotted in NGC 4569 as recently as 2004. While the duo is visible in smaller scopes as two, with soft twin nuclei, intermediate and large telescopes will see an almost V-shaped or heart-shaped pattern where the structures overlap. If you’re doing double galaxy studies, this is a fine, bright one! If you see a faint galaxy in the field as well, be sure to add NGC 4564 to your notes. Moving about a degree north will call up face-on spiral galaxy M89, which will show a nice core region in most telescopes. One half degree northeast is where you will find the delightful 9.5 magnitude M90 – whose dark dust lanes will show to larger telescopes.



Virgo contains many, many more fine objects – so be sure to get a detailed star chart and spend some time with this great constellation!

Sources:
Wikipedia
SEDS
Chandra Observatory

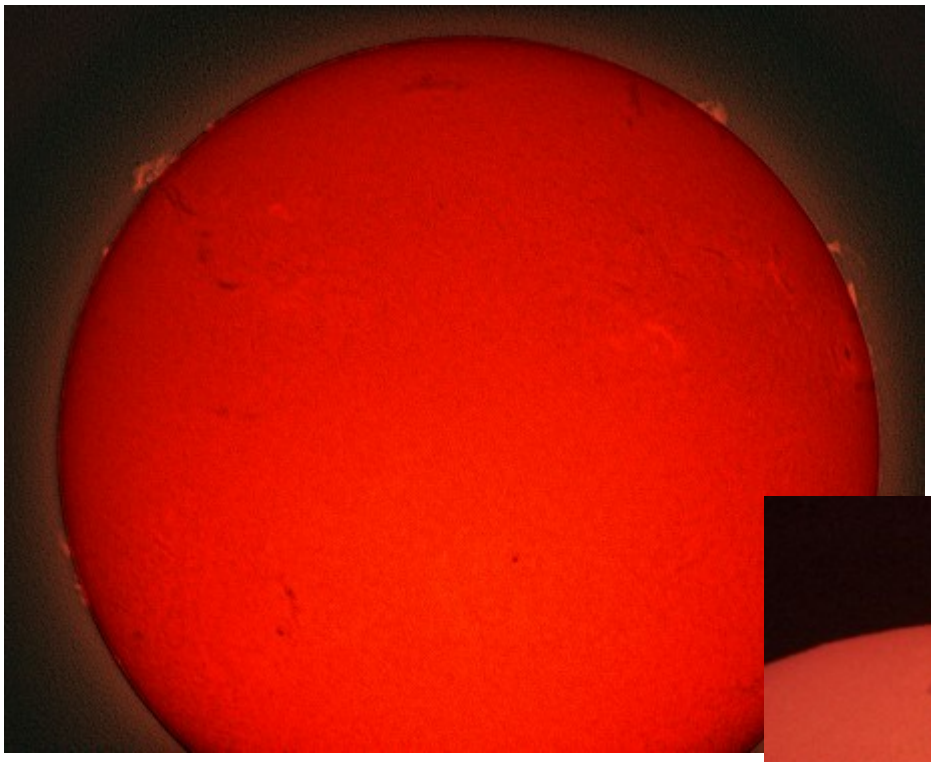
ISS PASSES For MAY 2022

from Heavens Above website maintained by Chris Peat.

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
03 May	-3.5	03:57:19	25°	SW	03:58:58	54°	SSE	04:02:15	10°	E
04 May	-3.2	03:10:37	40°	SSE	03:10:44	40°	SSE	03:13:53	10°	E
04 May	-3.8	04:44:00	10°	W	04:47:21	89°	NNE	04:50:42	10°	E
05 May	-3.9	03:56:44	19°	WSW	03:58:59	82°	SSE	04:02:20	10°	E
06 May	-3.9	03:09:54	48°	SW	03:10:38	68°	SSE	03:13:57	10°	E
06 May	-3.7	04:44:02	10°	W	04:47:23	86°	N	04:50:44	10°	E
07 May	-3.0	02:23:02	41°	ESE	02:23:02	41°	ESE	02:25:32	10°	E
07 May	-3.8	03:55:55	12°	W	03:58:57	85°	N	04:02:19	10°	E
08 May	-3.9	03:09:00	30°	W	03:10:31	90°	N	03:13:51	10°	E
08 May	-3.8	04:43:56	10°	W	04:47:17	78°	S	04:50:37	10°	ESE
09 May	-4.0	02:22:02	80°	S	02:22:03	80°	SSE	02:25:24	10°	E
09 May	-3.8	03:55:28	10°	W	03:58:50	89°	SSE	04:02:10	10°	E
10 May	-2.4	01:35:02	30°	E	01:35:02	30°	E	01:36:54	10°	E
10 May	-3.8	03:07:54	17°	W	03:10:19	85°	N	03:13:40	10°	E
11 May	-3.8	02:20:51	44°	W	02:21:47	85°	N	02:25:08	10°	E
11 May	-3.8	03:55:13	10°	W	03:58:32	66°	SSW	04:01:50	10°	ESE
12 May	-3.6	01:33:44	63°	E	01:33:44	63°	E	01:36:36	10°	E
12 May	-3.9	03:06:40	10°	W	03:10:00	80°	SSW	03:13:21	10°	ESE
13 May	-2.1	00:46:30	25°	E	00:46:30	25°	E	00:48:01	10°	E
13 May	-3.9	02:19:20	21°	W	02:21:26	89°	NNE	02:24:47	10°	E
13 May	-3.3	03:54:53	10°	W	03:58:01	39°	SSW	04:01:09	10°	SE
14 May	-3.8	01:31:38	37°	W	01:32:49	85°	N	01:36:10	10°	E
14 May	-3.7	03:06:14	10°	W	03:09:29	53°	SSW	03:12:45	10°	SE
14 May	-3.6	23:04:18	10°	SW	23:07:32	48°	SSE	23:10:46	10°	E
15 May	-3.9	00:40:50	10°	W	00:44:11	86°	N	00:47:32	10°	E
15 May	-3.9	02:17:35	10°	W	02:20:55	68°	SSW	02:24:13	10°	ESE
15 May	-3.2	22:15:54	10°	SW	22:18:58	35°	SSE	22:22:03	10°	E
15 May	-3.9	23:52:10	10°	W	23:55:31	88°	S	23:58:51	10°	E
16 May	-4.0	01:28:56	10°	W	01:32:16	82°	SSW	01:32:25	78°	SE
16 May	-3.9	23:03:30	10°	WSW	23:06:50	76°	SSE	23:10:11	10°	E
17 May	-3.9	00:40:14	10°	W	00:43:35	88°	N	00:44:38	41°	E
17 May	-3.8	22:14:52	10°	WSW	22:18:10	60°	SSE	22:21:28	10°	E
17 May	-3.8	23:51:31	10°	W	23:54:52	85°	N	23:57:16	18°	E
18 May	-2.5	01:28:16	10°	W	01:30:07	29°	W	01:30:07	29°	W
18 May	-3.8	23:02:46	10°	W	23:06:07	87°	N	23:09:28	10°	E
19 May	-3.9	00:39:31	10°	W	00:42:49	71°	SSW	00:42:49	71°	SSW
19 May	-3.8	22:14:00	10°	WSW	22:17:21	86°	SSE	22:20:42	10°	E
19 May	-3.9	23:50:45	10°	W	23:54:05	84°	SSW	23:55:32	31°	ESE
20 May	-3.8	23:01:56	10°	W	23:05:18	87°	NNE	23:08:15	13°	E
21 May	-2.9	00:38:42	10°	W	00:41:06	36°	WSW	00:41:06	36°	WSW
21 May	-3.7	22:13:06	10°	W	22:16:28	85°	N	22:19:49	10°	E
21 May	-3.8	23:49:51	10°	W	23:53:09	58°	SSW	23:53:49	46°	SSE
22 May	-3.9	23:00:59	10°	W	23:04:20	74°	SSW	23:06:32	19°	ESE
23 May	-3.8	22:12:07	10°	W	22:15:28	87°	S	22:18:48	10°	E
23 May	-3.0	23:48:55	10°	W	23:51:59	34°	SSW	23:52:05	33°	SSW
24 May	-3.4	22:59:57	10°	W	23:03:11	46°	SSW	23:04:47	24°	SE
25 May	-3.7	22:10:59	10°	W	22:14:18	62°	SSW	22:17:30	11°	ESE
26 May	-2.4	22:58:56	10°	W	23:01:46	26°	SSW	23:03:04	20°	S
27 May	-2.9	22:09:49	10°	W	22:12:55	36°	SSW	22:15:46	11°	SE

END IMAGES, OBSERVING AND OUTREACH

The Sun has increasing activity through April. Lots of Sunspots, but nowehere neare the size of 2003/3 peaks. Here the Halpha shot taken in colour using ZWO webcam on SolarScopes 60mm scope. The bottom picture taken using white light filter on Nikon Coolpix P1000 bridge camera using in built zoom lens.
Andy Burns



Observing Sessions and Covid19 - Update

Proposed Observation Sessions for 2021-2022

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:

- **Try Friday 6th May 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
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.