NWASNEWS

Volume26 Issue 4

DECEMBER 2020

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

All the Best For the Christmas Period. Stay Safe

There will be many reasons to be glad to have 2020 behind us, and if we keep sensible and vaccines work we may be back to normal by May or June.

It has been frustrating. And in November for the 2nd wave lockdown we did not have good weather for astronomy. The odd hour here and there between full Moons that spread the glow around the sky. But the evenings have been blessed with the sight of Jupiter and Saturn getting closer and closer. All behind tree for me but by the 21st December, Winter Solstice, we are due for the closest conjunction between these two planets since 1226. Nearly 800 years. Worth getting a travelling telescope and getting out to a clear position. Saturn will be in line of sight closer than Calisto.

The meteor shower of the Geminids on the 16th/17th should be nearly moonless and the radiant is up high before 10pm, the best shower of the year.

But if you can't get out there to see the skies, well in none covid times there are planetariums, and one of the oldest of these is the **Eise Eisinga Planetarium** in the Netherlands. Based on an orrery, so physical planets rather than projections, this planetarium is the topic for our talk be Dr Lilian Hobbs this evening.

Hope you all stay well and have clear skies

Andy

December Zoom Meeting

Topic: WAS December Zoom MeetingDr Lilian Hobbs/Eisa Eisinga: The Planetarium in the Bedroom.

Time: Dec 1, 2020 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/86130423379?pwd=TXRiYk1CSkwzLzZkaFRXdHZuRi9rZz09

Meeting ID: 861 3042 3379

Passcode: 580823

25/11/2020
82% Lit Waxing Gibbous Moon

Canon X50HS 1200mm, ISO 80, F8, 1/125 sec

35 raw images converted to tiff in Canon DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.
John Dartnell

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.
During COVID19 ZOOM meetingd

HALL VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

SEASON 2020/21
1 Dec Dr Lilian Hobbs/Eisa Eisinga: The Planetarium in the Bedroom.
2021
5 Jan Paul Money 'Triumphs of Voyager (part 2) – Where no probe has gone before'.
2 Feb Prof David Southwood/Moon and Mars the next Giant Leap.
2 Mar Pete Williamson/The moon & Moons of the Solar System.
6 Apr Prof Mike Edmunds/The Clockwork universe.
4 May TBC
1 Jun Robert Harvey/Understanding the Universe.

Thank you Peter and those that have helped get a list together in the circumstances.

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns Chair, anglesburns@hotmail.com
Andy Burns Outreach and newsletter editor.
Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)
Philip Proven (Hall coordinator) Dave Buckle (Teas)
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Nick Howes (Technical Guru)
Observing Sessions coordinators: Chris Brooks, Jon Gale,
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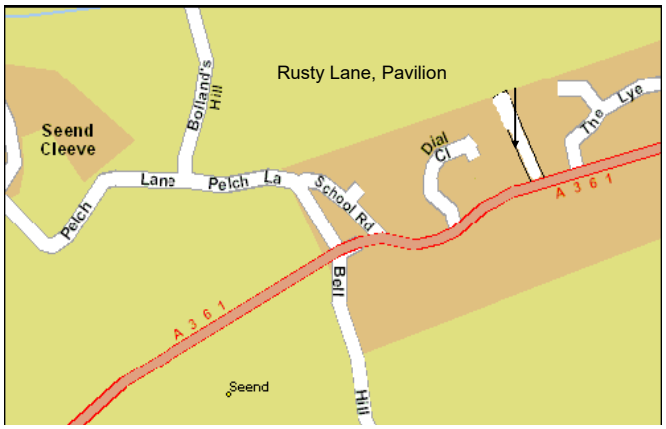
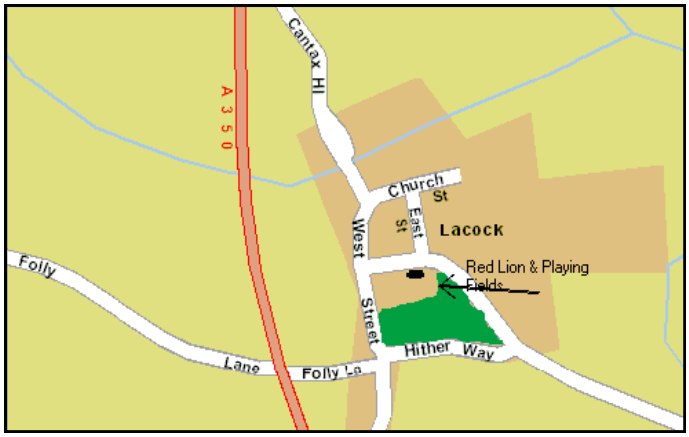
Contact via the web site details.



Observing Sessions see back page



Dr Lillian Hobbs

I have been interested in Astronomy for many years. My first telescope, a small refractor, was purchased from Dixons and served me very well. I still have a paperweight containing my first astro photograph, the moon. Since then I have purchased several telescopes and I currently like Meade, Celestron , Takahashi & TMB Telescopes.

The Meade ETX/EC-90 or the 125 , is ideal for travelling and I have taken my 90 on several business trips which enabled me to see the transit of Mercury. Under clear skies, the views in the ETX are great and I highly recommend it.

My other telescopes include a TMB 7" and an Astro-Physics 4.75" refractor on a Paramount ME mount which is housed in a dome and is being used to observe deep-sky objects. There is another dome with houses a Celestron 11" on an NEQ6 which is used for planetary imaging. For wide-field imaging I use a Takahashi FS60. I also have a Coronado Nearstar and a Solarmax 90 filter to observe solar prominences..

Eise Eisinga Planetarium The **Royal Eise Eisinga Planetarium** (Dutch: *Koninklijk(e) Eise Eisinga Planetarium*) is an 18th-century orrery in Franeker, Friesland, Netherlands. It is currently a museum and open to the public. The orrery has been on the top 100 Dutch heritage sites list since 1990 and in December 2011 was placed on a provisionary list of future UNESCO World Heritage Site candidates. It is the oldest working orrery in the world.

The orrery was built from 1774 to 1781 by Eise Eisinga, a wool comber and amateur astronomer.

Eise Eisinga's machinal planetarium is built into the timber roof of the living room ceiling of his historic canal house. William I, Prince of Orange and the first King of the Netherlands was so impressed with the planetarium, he purchased the house and it became a royal planetarium.[1]

The museum consists of the planetarium room, a screening room where documentaries are shown, and special exhibits based on modern astronomy. Other parts on permanent display are Eisinga's former wool combing establishments and a collection of historical astronomical instruments. Historical astronomical instruments in the collection include Georgian telescopes and an 18th century octants and tellurium, an educational model of the Sun, Earth and Moon.[1]

The museum has a Planetarium Café and Brasserie De Stadstuin located in the former Van Balen coffee-roasting house.

Swindon Stargazers

Swindon's own astronomy group

Meetings cancelled

Due to the current crisis our meetings, like many other physical meetings have been suspended and replaced with Zoom meetings.

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

For insurance reasons you need to be a club member to take part. If you think you might be interested email the organiser Robin Wilkey (see below). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.

We are a small keen group and I would ask you to note that you DO NOT have to own a telescope to take part, just turn up and have a great evening looking through other people's scopes. We are out there to share an interest and the hobby. There's nothing better than practical astronomy in the great cold British winter! And hot drinks are often available, you can also bring your own.

Enjoy astronomy at it's best!

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 2020

Friday 11 December Zoom meeting

Programme: Prof. Martin Hendry FRSE: Einstein Goes to Hollywood

Meeting Dates for 2021

Friday 15 January Zoom meeting
Programme: David Bryant: Meteorites and their planet of origin

Friday 19 February Zoom meeting
Programme: Prof Rene Breton: Cosmic Fireworks

Friday 19 March Zoom meeting
Programme: AGM + speaker: Viv Williams 'Setting up and using telescope mounts'

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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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

This young astronomy club meets at the
Sutton Veny Village Hall.
Second Thursday of the Month.

STAR QUEST ASTRONOMY CLUB

Meet at Sutton Veey near Warminster.

BATH ASTRONOMERS

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

The third of our series of Zoom lectures is coming up at 7.30 pm on Friday 6th November. You may have already received an email about it. I am making a special effort to reach out to more people with this one, as it crosses the boundary between Art and Physics, so it would be great if you could make your colleagues in the Wiltshire Astro Soc and others aware that this is an especially good lecture.

Venue: 7.30 pm Friday 6th November 2020 online as a BRLSI Zoom lecture
Title: How the sun Paints the Sky
Speaker: Dr Robert (Bob) Fosbury
Tickets: https://www.eventbrite.co.uk/e/live-how-the-sun-paints-the-sky-tickets-124064982703, proceeds to the BRLSI.

Description:
Unless they are astronauts, humans must view the Universe through the window of the Earth's atmosphere. Although a clear sky is relatively transparent to visible light, bright astronomical objects — most noticeably the Sun — can paint the entire sky with luminosity, colour and shadow to be captured by both landscape painters and photographers. How does this happen and what physical processes are responsible for these beautiful colours, gradations and patterns? The talk explains some of this and is illustrated with spectacular images of the sky from space and from above the European observatories in the Chilean Atacama desert.
Background of speaker:
Dr Bob Fosbury worked for the European Space Agency (ESA) as part of ESA's collaboration with NASA on the Hubble Space Telescope (HST) project at ST-ECF. Based at the European Southern Observatory (ESO) near Munich in Germany, Fosbury joined this initiative in 1985, more than 5 years before launch. During the latter part of this period, Bob served on NASA's Ad Hoc Science Working Group and ESA's Study Science Team as they developed the instrument concepts for the James Webb Space Telescope, the next generation space observatory.
He is currently an emeritus astronomer at the European Southern Observatory and an honorary professor at the Institute of Ophthalmology at UCL.

Bob Fosbury lives in Bath and is a very good speaker. He is particularly interested in light and colour and his approach crosses a number of fields. This lecture wil interest people ranging from scientists to artists, his first slide is of Turner's Fighting Temeraire and introduces a discussion of the colour palette that Turner used for the sunset.

For everyone who participates, I can promise that your enjoyment of future sunsets will be enhanced!

I should point out that we continue to charge for these lectures (£5, £2 for members and students) because our partners at the BRLSI where we normally hold our lectures are in severe financial difficulty since their room hire income has disappeared. They have a building to maintain and although supported by many volunteers they also have some staff whose livelihoods are under threat. So the ticket proceeds all go to the BRLSI. To participate in the lecture and the Q & A session afterwards, you need to go to the above link to Eventbrite to buy tickets. If you prefer, you can also watch the lecture on the BRLSI's Youtube channel at no cost when it is added a month later - just go to the BRLSI Events page in December.

If you know anyone who might be interested, please pass this email on. Note the discounted rate for school kids and students.

Best regards,

Tony

SPACE NEWS FOR NOVEMBER

A Soyuz rocket carrying a military spy satellite for the United Arab Emirates is set for liftoff from French Guiana at 8:33 p.m. EST Tuesday (0133 GMT Wednesday). A launch attempt Sunday night was scrubbed due to the risk of lightning, and a countdown Monday was called off due to a telemetry issue associated with the range safety system at the Guiana Space Center.
A Japanese satellite designed to relay data and imagery from civilian and military Earth observation spacecraft launched Sunday aboard an H-2A rocket.
China launches ambitious mission to return lunar material to Earth

November 23, 2020 Stephen Clark

A Long March 5 rocket lifts off from the Wenchang launch center Monday. Credit: CNSA/CLEP
A heavy-lift Long March 5 rocket hurled a 9-ton Chinese spacecraft toward the moon Monday on a 23-day mission attempting to return lunar samples to Earth for the first time in 44 years.
The nearly 20-story rocket fired off its launch pad at the Wenchang space center on Hainan Island in southern China at 3:30 p.m. EST (2030 GMT) Monday with 2.4 million pounds of thrust from 10 liquid-fueled engines.
The Long March 5 rocket is the most powerful launcher in China's inventory. The launch of the Chang'e 5 lunar sample return mission was delayed by earlier problems with the Long March 5, including a launch failure in 2017 that grounded Long March 5 flights for more than two years.
The rocket worked flawlessly on the launch of Chang'e 5, which occurred at 4:30 a.m. Beijing time Tuesday.
The rocket shed four kerosene-fueled boosters around three minutes after launch, then jettisoned its 17-foot-diameter (5.2-meter) payload shroud after climbing into space. The Long March 5's cryogenic core stage, powered by two hydrogen-fed main engines, propelled the Chang'e 5 spacecraft to near orbital velocity.
Twin hydrogen-fueled engines performed two burns to power the 18,000-pound (8.2-metric ton) Chang'e 5 spacecraft on a trajectory toward a point a quarter-million miles from Earth, where it will enter orbit around the moon within a few days.
The exact timeline for the mission has not been released by Chinese officials, but the spacecraft is expected to release a lander to touch down near Mons Rümker, a volcanic formation that extends more than 4,000 feet — or about 1,300 meters — above the surrounding lava plains.
Chang'e 5's landing site is located in the Oceanus Procellarum, or Ocean of Storms, region in the northern hemisphere of the near side of the moon. The touchdown is expected to occur before the end of November, and the surface mission will occur during a two-week window of daylight at the landing site, allowing solar energy to power the spacecraft.

Once on the moon, Chang'e 5 will extract up to 4.4 pounds, or 2 kilograms, of material from a depth of up to 6.6 feet, or 2 meters, below the surface. Then the specimens will launch back into lunar orbit aboard a small rocket, rendezvous with a return craft, and head for Earth.
The return carrier will re-enter the atmosphere at some 25,000 mph, or 40,000 kilometers per hour, significantly faster than a re-enter from low Earth orbit. The capsule will will land around Dec. 15 in China's Inner Mongolia region, where teams will retrieve the moon specimens and transport the material to a lab for analysis.

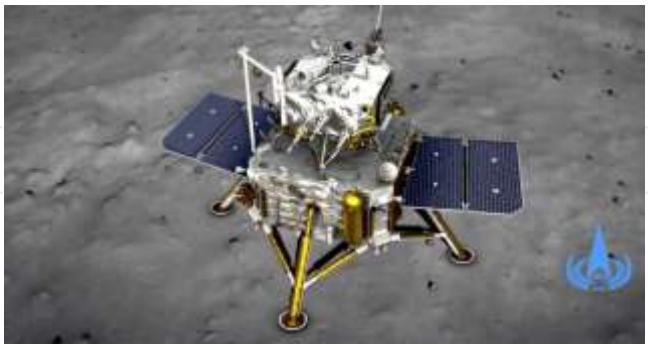


Illustration of the Chang'e 5 lander on the moon. Credit: CNSA
Clive Neal, a lunar scientist at the University of Notre Dame, said China has proven it can land on the moon with previous missions.
"But then they have to collect the sample," Neal said. "The interesting thing is they launch from the moon, get into lunar orbit, and then rendezvous with the Earth re-entry vehicle that will bring that sample back to Earth safely and uncompromised. When the Soviets did it in 1976, the last time, it was direct to Earth. They launched form the moon and came straight back to Earth. This one has an extra strp in there, which has to go well in order for the sample to actually make it back.
"But given the capability they've demonstrated with doing things for the first time, such as the far side landing and roving, I expect things to be successful, and hope they are," Neal said in an interview with Spaceflight Now.
The sample return mission, if successful, will mark the first time lunar material has been returned to Earth since 1976, when the Soviet Union's robotic Luna 24 mission brought back around 170 grams, or 6 ounces, of specimens from the lunar surface.
Nine missions have returned moon samples to Earth, including NASA's six Apollo missions with astronauts, and three robotic Luna spacecraft launched by the Soviet Union.
NASA's Apollo missions brought back 842 pounds (382 kilograms) of rocks from the moon.
There is evidence that rocks in Chang'e 5's landing zone are much younger than those returned by the Apollo astronauts. Those specimens are some 3.5 billion years old, created during a period of active volcanism in the first billion years of the moon's existence.
Lava plains to the east of Mons Rümker appear to be less battered by asteroid impacts, suggesting rocks there could be less than 2 billion years old. But models of the moon's evolution suggest its internal heating should have diminished by that time, rendering volcanoes extinct, Neal said.
"It will be exciting to look at the age of these samples coming back and also the actual compositions of them," Neal said.
"China is doing a great job here in terms of their first sample return mission," said James Head, a planetary scientist at Brown University, during remarks broadcast on Chinese state television. "We haven't been returning samples for 44 years, and we have many scientific questions which the Chang'e 5 mission is going to help us answer. This is really exciting opportunity, and we really appreciate China's efforts in this area."
Before Chang'e 5, China has successfully dispatched four robotic explorers to the moon, beginning with the Chang'e 1

and Chang'e 2 orbiters in 2007 and 2010. In 2013, China landed the Chang'e 3 mission on the moon with a mobile rover that drove across the lunar surface.
China's most challenging lunar mission to date was Chang'e 4, which accomplished the first-ever soft landing on the far side of the moon in January 2019. Chang'e 4's rover continues operating, sending back imagery and scientific data through a dedicated relay satellite China placed in a position beyond far side of the moon to transmit signals between Earth and the Chang'e 4 spacecraft.

The European Space Agency is using tracking stations in French Guiana and Spain to communicate with China's Chang'e 5 mission. Credit: ESA
The Chang'e missions are named for a moon goddess in Chinese folklore.
China has a backup to the Chang'e 5 spacecraft named Chang'e 6. If Chang'e 5 is successful, Chang'e 6 could attempt a sample return mission from the far side of the moon.
Unlike Chang'e 5, which is an all-Chinese mission, the Chang'e 6 spacecraft will carry foreign instruments to the lunar surface. The French space agency, CNES, announced last year that it will provide an instrument for the Chang'e 6 mission to study the moon's exosphere and water cycle.
China is also planning a robotic station on the moon's south pole before a possible landing on the moon with Chinese astronauts in the 2030s.
Chinese officials have signaled they are open to partnering with other countries on lunar exploration. Instruments developed by scientists in Sweden, Germany, and Saudi Arabia have flown to the moon on past Chinese mission.
The European Space Agency said it provided tracking support during the initial phases of the Chang'e 5 mission after launch Monday, and will offer similar communications relay support during the spacecraft's return to Earth next month.
NASA is legally barred from any cooperation with China on space exploration projects.
"With Chang'e 5, China has launched an effort to join the U.S. and the former Soviet Union in obtaining lunar samples," NASA said in a statement posted on Twitter. "We hope China shares its data with the global scientific community to enhance our understanding of the moon like our Apollo missions did and the Artemis program will."
NASA's Artemis program aims to return astronauts to the lunar surface in the 2020s.
Neal said he would be surprised if the Chang'e 5 samples are distributed outside of China, at least initially.
"I don't expect them to come to the U.S. given the souring of relations between China and the U.S. at the political level," Neal said. "However, I think there will be potential collaborations between scientists. The lunar science community is international in nature, and we tend to get along pretty well. So I'm hoping the results will be made available through our science colleagues, even if the samples can't come out of China."
Five days after taking off on a heavy-lift Long March 5 rocket, China's Chang'e 5 sample return spacecraft entered orbit around the moon Saturday, moving into position for a descent to the lunar surface in a bid to gather specimens and bring them back to Earth.

SpaceX launches 60 more Starlink satellites on 100th Falcon 9 flight

November 25, 2020

The 100th flight of a Falcon 9 rocket delivered 60 satellites to orbit for SpaceX's Starlink network Tuesday night, adding another building block to a planned fleet of thousands of solar-powered space-based relay stations to beam broadband connectivity around the world.

International satellite launches to extend measurements of sea level rise

November 21, 2020

A European-built satellite with the unusual shape of a house launched into orbit Saturday aboard a SpaceX Falcon 9 rocket from California's Central Coast, carrying a sophisticated radar altimeter to measure rising sea levels on our home planet. A SpaceX Falcon 9 rocket lifted off from Space Launch Complex 4-East at Vandenberg Air Force Base in California at 12:17 p.m. EST (9:17 a.m. PST; 1717 GMT) Saturday with an oceanography satellite jointly developed by U.S. and European space and weather agencies. The rocket's first stage booster returned to a bullseye landing back at Vandenberg.

The sun fires off its biggest solar flare in more than 3 years

By Chelsea Gohd 17 hours ago

The M4.4-class solar flare was a medium-strength sun storm.
The sun unleashed its most powerful solar eruption in more than three years on Sunday (Nov. 29).
The solar flare, which is a sudden, bright explosion of electromagnetic energy, measured as an M4.4 on the scale astronomers use for sun storms. M-class flares are medium-sized eruptions (compared to small C-class flares and large X-class flares) and rank on a scale from 1 to 9, with larger numbers representing stronger flares.
The M4.4 flare's bright burst was accompanied by a coronal mass ejection, which can often accompany solar flares. Coronal mass ejections are large releases of plasma and magnetic fields from the sun's corona, or its outermost layer.
This flare kicked off a brand new solar cycle (solar cycle 25), which began in December 2019 and was announced in September. The previous solar cycle ran from 2008 to 2019 and, while this new solar activity phase started off with this powerful explosion, scientists estimate that it will be fairly quiet, much like solar cycle 24 before it.
Solar weather follows an 11-year activity cycle and tracking these cycles and the sun's ever-changing activity is critical not just for science but also for our daily lives here on Earth.
Solar flares and coronal mass ejections release incredible bursts of electromagnetic radiation. These sudden energy expulsions can be so intense that their effects can reach Earth, causing radio blackouts and other technological disruptions.
But, while X-class solar flares might be capable of causing radio blackouts around the globe, M-class flares like the one we experienced on Sunday typically trigger only minor consequences on our home planet.
With this bright burst, X-rays and ultraviolet radiation from the solar flare created a shortwave radio blackout over the Southern Atlantic ocean, astronomer Tony Phillips reported

at Spaceweather.com, detailing some of the technological effects of this flare.
Although the flare appeared as an M-class from Earth, it may actually have been a stronger flare, since the event took place partially behind the sun. "The explosion was partially eclipsed by the body of the sun. It might have been an X-class event," Phillips wrote. Spacecraft had a better view of the flare, however, so soon we should have more clarification on the exact size of the event.

Jupiter's ocean moon Europa may spout water plumes from its icy crust

By Mike Wall 4 days ago

The intriguing moon could have multiple plume types.

The Jupiter moon Europa, as imaged by NASA's Galileo spacecraft.
(Image: © NASA/JPL-Caltech/SETI Institute)
The Jupiter moon Europa may cough water into space from small pockets in its icy crust, a new study suggests.
Europa, one of Jupiter's four big Galilean moons, harbors a huge ocean of salty water beneath its ice shell and is widely regarded as one of the solar system's best bets to host alien life.

NASA's Hubble Space Telescope and other instruments have spotted evidence of sporadic plumes of water vapor that rise perhaps 120 miles (200 kilometers) above Europa's frigid surface. This water may be coming from the buried ocean, raising the exciting possibility that a spacecraft could sample this potentially life-supporting environment without even touching down on the moon.
Such sampling work might be done by NASA's Europa Clipper probe, which is scheduled to launch in the mid-2020s. Clipper will orbit Jupiter and study Europa during dozens of close flybys, characterizing the ocean and the ice shell and scouting out possible touchdown sites for a future life-hunting lander. (Clipper team members have stressed that the probe will likely have to get lucky to pull off a sampling run, however, given that Europa's plume activity isn't well characterized and appears to be sporadic.)
Those apparent big plumes may have smaller cousins, which are emanating from a source just below the surface, according to the new research.
The scientists, led by Gregor Steinbrügge of Stanford University and Joana Voigt of the University of Arizona, analyzed Europa's Manannán Crater, an 18-mile-wide (29 km) feature created by an impact tens of millions of years ago.
The heat generated by this impact doubtless melted a considerable portion of the nearby ice, and the researchers modeled what happened next. They found that some pockets of salty liquid brine likely survived for a spell after most of the meltwater had refrozen. In addition, the team determined that such pockets could move laterally through Europa's shell, by melting some of the adjacent ice.
The modeling work further suggested that such migration happened at Manannán: A pocket probably made its way to the crater's center and then began to freeze, causing a pressure buildup that eventually blasted out a roughly 1-mile-high (1.6 km) plume.
There is evidence that such a plume did actually exist — a spider-shaped feature at Manannán that was spotted by NASA's Galileo spacecraft, which studied the Jupiter system while orbiting the giant planet from 1995 to 2003. (The researchers worked this spidery imprint into their model.)
"Even though plumes generated by brine pocket migration would not provide direct insight into Europa's ocean, our findings suggest that Europa's ice shell itself is very dynamic," Voigt said in a statement.
"The work is exciting, because it supports the growing body of research showing there could be multiple kinds of plumes on Europa," Europa Clipper project scientist Robert Pappalardo, of NASA's Jet Propulsion Laboratory in Southern California, said in the same statement. "Understanding plumes and their possible sources strongly contributes to Europa Clipper's goal to investigate Europa's habitability."
The new study was published this month in the journal Geophysical Research Letters.

New jets seen blasting out of the center of a galaxy

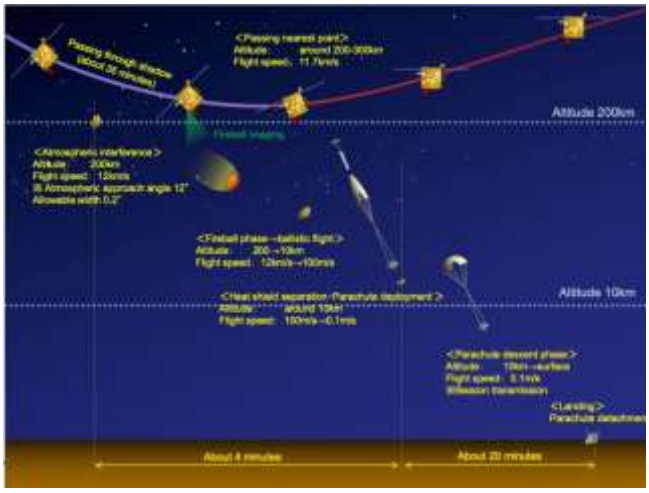
Giant black holes can launch jets that extend for tens of thousand of light-years, blasting clean out of their host galaxies. These jets can last for tens of millions of years. Recently astronomers have spotted the first-ever jet in the process of forming, creating a cavity in the span of only twenty years.
Almost every galaxy is thought to host a giant black hole in its center. These black holes are so big that they get a new name: *supermassive* black holes. But not only do they consume anything that happens to wander too closely, they also develop massive disks of material swirling around them. These accretion disks become incredibly bright, as tons upon tons of gas and dust try to squeeze down towards the black hole. That inward motion increases the densities, and friction within the material causes the temperatures to skyrocket.
As the gas and dust swirls in, it flattens to form a razor-thin disk, spinning at a healthy fraction of the speed of light. That disk generates extremely strong electric and magnetic fields, which causes some of the gas to spin around the black hole, eventually skimming the surface and blasting out in the form of twin jets.
These jets cause havoc. They can disrupt the formation of stars, blow holes in galaxies, and even escape out into intergalactic space.
For decades astronomers have been observing these jets using radio telescopes: the jets themselves are wrapped in strong magnetic fields, like a straw around the soda you're slurping up, which produce extremely bright radio emissions. And recently astronomers at the U.S. Naval Research Laboratory used the Karl G. Jansky Very Large Array to witness something remarkable: the birth of these jet systems.

A young radio jet launching from a supermassive black hole in the center of a distant galaxy. (Photo illustration by National Radio Astronomy Observatory, Credit: Sophia Dagnello, NRAO/AUI/NSF)
They accomplished this by running a survey of the radio sky,

called – appropriately enough – the Very Large Array Sky Survey (VLASS). They then looked for bright sources that did not exist in older surveys. By comparing the two surveys, they could spot anything new that's cropped up in the past couple decades.
The astronomers found multiple examples of jets blasting out of galaxies where twenty years ago they had been silent. This is the first time that astronomers have caught the formation of jets in the act. Further observations will reveal how those newborn jets shape and sculpt the surrounding galaxies, and ultimately impact their evolution.

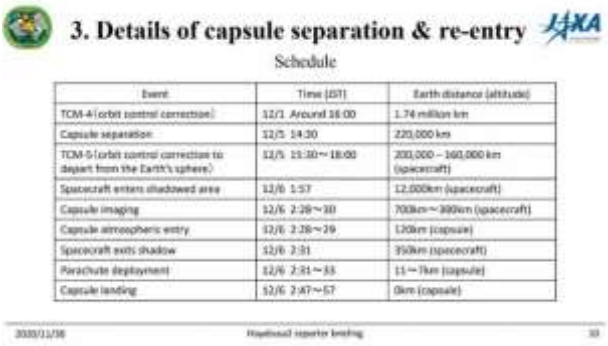
Hayabusa 2's Sample is Landing on Earth December 6th

Japan's Hayabusa 2 spacecraft is nearly back home, with precious cargo aboard! The sample-return mission departed asteroid Ryugu (162173 Ryugu) a little over a year ago, with soil samples and data that could provide clues to the early days of our Solar System. On December 6, 2020, the sample return container is set to land in the Australian outback.
"Organic materials are origins of life on Earth, but we still don't know where they came from," said Makoto Yoshikawa, Hayabusa 2 project mission manager, at a press briefing. "We are hoping to find clues to the origin of life on Earth by analyzing details of the organic materials brought back by Hayabusa 2."
JAXA, the Japanese space agency, said the capsule containing the samples should land in the Woomera Prohibited Area in Australia, a restricted military test site about 122,000 square kilometers in size, located approximately 450 km northwest of Adelaide. JAXA's YouTube will have livestreams of the event.



Details of Hayabusa 2 capsule separation & re-entry. Credit: JAXA.

On November 25, the Hayabusa 2 team received permission from Australia to transition to the re-entry orbit. They conducted a trajectory correction maneuver on November 26 to put the spacecraft into the correct entry corridor.
The spacecraft will drop the capsule containing the samples from a distance of about 220,000 km (136,700 miles) from Earth. The capsule is quite small, only about 40 cm (15 inches) in diameter. A heat shield will protect the capsule during its fiery plunge through our atmosphere. When the capsule reaches an altitude of about six miles above the ground, a parachute will open to allow for a – hopefully – soft landing. A beacon will activate to transmit the location of the capsule, and multiple receivers have been set up around the target area to retrieve those signals. Radar, drones, and helicopters will be at the ready to assist in the search and retrieval. Without those measures, a search for the small capsule "would be an extremely difficult," Yoshikawa said.
Below is the timeline of events, as of 11/30/20. Japan Standard Time (JST) is **UTC +9**. If you happen to live in Australia, here's information about how you may be able to see the capsule drop.


3. Details of capsule separation & re-entry

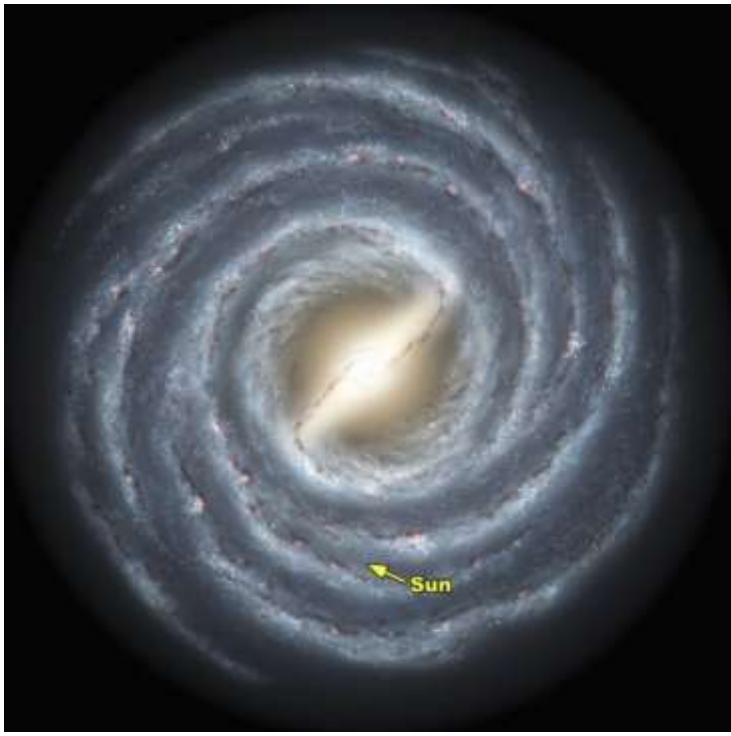
Schedule

Event	Time (JST)	Earth distance (altitude)
TCM-4 (orbit control correction)	12/1 Around 16:00	1.74 million km
Capsule separation	12/5 14:30	220,000 km
TCM-5 (orbit control correction to depart from the Earth's sphere)	12/5 15:30~18:00	200,000 – 160,000 km (spacecraft)
Spacecraft enters shadowed area	12/6 1:57	12,000km (spacecraft)
Capsule imaging	12/6 2:28~30	700km~ 300km (spacecraft)
Capsule atmospheric entry	12/6 2:28~29	120km (capsule)
Spacecraft exits shadow	12/6 2:31	350km (spacecraft)
Parachute deployment	12/6 2:31~33	11~7km (capsule)
Capsule landing	12/6 2:47~57	0km (capsule)

Hayabusa 2 launched in December 2014, and arrived at Ryugu in mid-2018. A German-built MASCOT lander collected samples from Ryugu in February and July 2019, storing each sample in separate chambers. The mission team said they believe at least 300 milligrams of material was collected, and likely more.
For the Hayabusa 2 spacecraft, it's not the end of the mission. After dropping the capsule, it will head to another distant small asteroid called 1998KY26, with the journey slated to take 10 years.

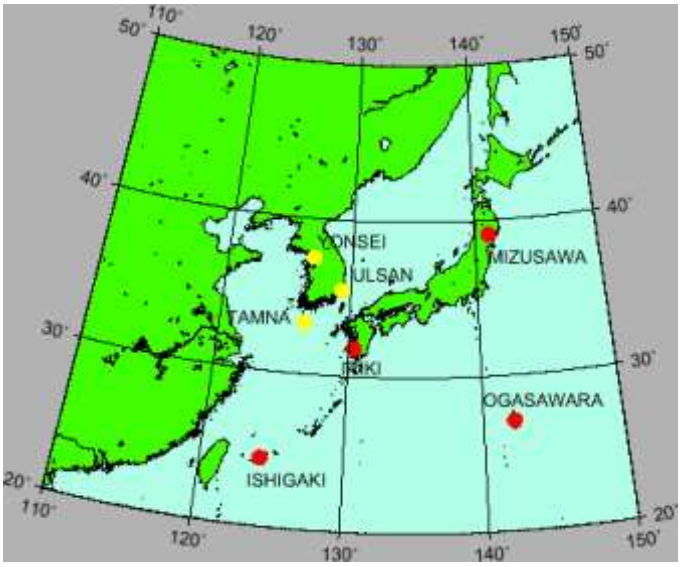
A new measurement puts the Sun 2,000 light-years closer to the centre of the Milky Way

Where are we? Cosmically, we're in our home galaxy, typically known as the Milky Way. The centre of our galaxy is marked by a supermassive black hole, which the Sun orbits at a distance of about 30,000 light-years. The official distance, set by the International Astronomical Union in 1985, is 27,700 light-years. But a new study as confirmed we are actually a bit closer to the black hole.
It's difficult to figure out where we are in the galaxy. For one thing, we're in the middle of it all, and a good chunk of our view is blocked by a region of gas and dust known as the zone of avoidance. We can't simply step outside our galaxy and pinpoint our location on a map. The task is so difficult that it was only a century ago that Harlow Shapley first determined the Sun isn't near the centre of the Milky Way.



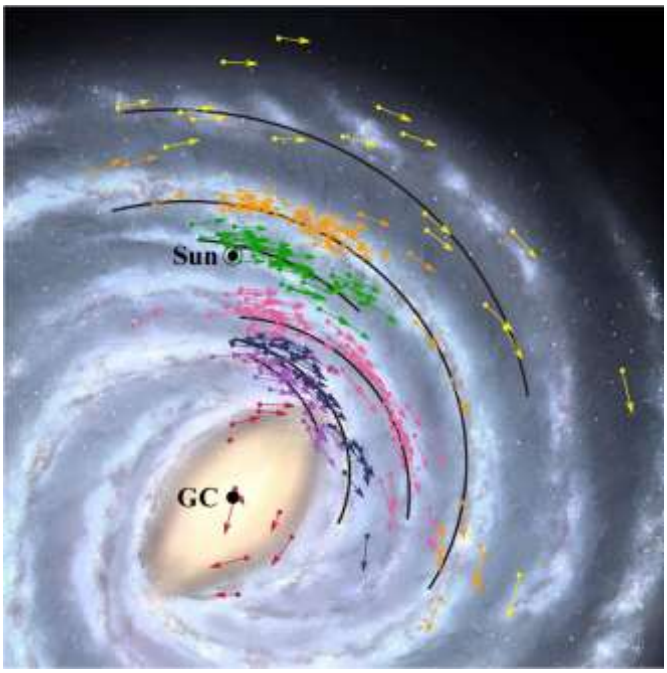
You are here, give or take. Credit: Caltech

The best way to determine our location is to measure the position and motion of lots of stars. That's easier said than done because motion is relative. While nearby stars orbit the Milky Way, so does the Sun, and we can only measure a star's motion relative to us. Additionally, stars don't follow the same general orbit. Some have more circular orbits, and others less circular. You need to measure enough to determine an aggregate motion of the Sun relative to the galaxy as a whole. But it is this type of measurement that has given us the official IAU distance.



Location of the VERA antennas. Credit: VERA

To get a better measure of our location, the team used a technique known as Very Long Baseline Interferometry (VLBI). This is where an array of widely separated radio antennas work together to observe an object. Since light takes time to travel, the signal from an object reaches each antenna at slightly different times. By timing the signals, the team can pinpoint the location of the object. In this case, the team used the VLBI Exploration of Radio Astrometry (VERA), which has antennas scattered across the Japanese archipelago. VERA can pinpoint the location of a star to within 10 micro-arcseconds, which is roughly equivalent to the width of a penny on the lunar surface.



By measuring stellar motions we can determine our location. Credit: NAOJ

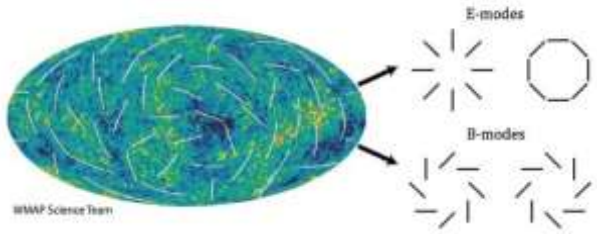
VERA has measured the position and motion of nearly a hundred stars in our galactic neighborhood. From this, the team determined that the Sun is 25,800 light-years from the galactic center. They also found that it orbits through the galaxy at a speed of 227 km/s, which is a bit faster than the official value of 220 km/s. This is just the team's first data release, so we can expect their measure to get more precise over time. VERA will also be collaborating with the East Asian VLBI Network (EAVN), which has antennas in South Korea and China. From this, the team will be able to pin down stars to within 0.5 micro-arcseconds. So in the near future, we will be a bit closer to knowing exactly where we are.

Reference: VERA collaboration, et al. "The First VERA Astrometry Catalog." *Publications of the Astronomical Society of Japan* 72.4 (2020): 50.

Polarized light from the cosmic background hints at new physics

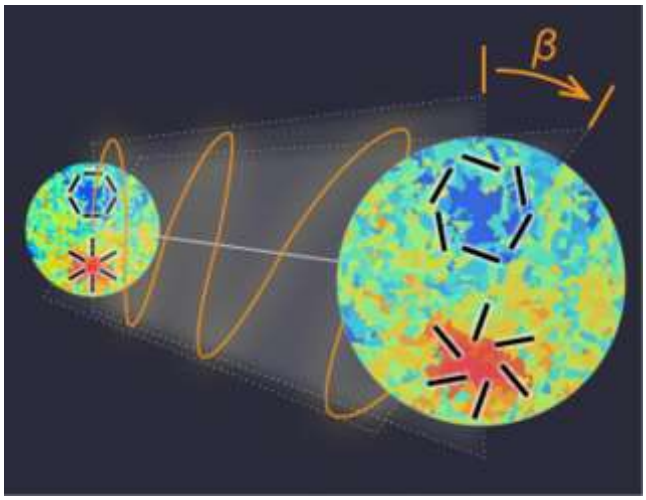
The oldest light in the universe is that of the cosmic microwave background (CMB). This remnant glow from the big bang has traveled for more than 13 billion years. Along the way, it has picked up a few tales about the history and evolution of the cosmos. We just need to listen to what it has to say.

One of the ways the CMB tells a story is through its polarization. If you think of light as an oscillating wave, then this wave motion can have different orientations, the orientation of a light wave's oscillation is known as its *polarization*. Often, light is a random jumble of orientations, making it unpolarized, but the light from the CMB is light that has scattered off the hot gas of the early universe and has an orientation known as E-mode polarization.



E-mode and B-mode polarization in the CMB. Credit: WMAP Science Team

If there were nothing but empty, flat space between us and the cosmic microwave background, then all the light from the CMB would be E-mode polarized. But deep space isn't empty. It's filled not only with diffuse gas and dust, but also dark matter and dark energy. As the light from the big bang travels through this, its polarization changes slightly, twisting through an angle, ?. This shifts the orientation of CMB light toward B-mode polarization.



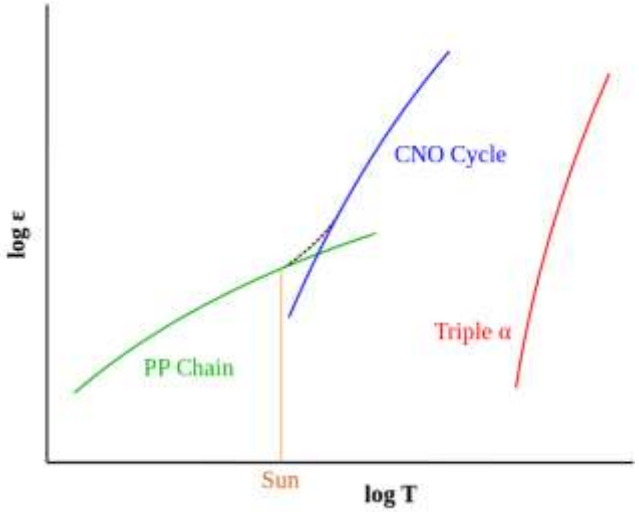
The orientation of polarized light changes as it moves through

the cosmos. Credit: Y. Minami / KEK
Studying this effect is very difficult, partly because the shift is so small, and partly because the source of the shift is difficult to pin down. But recently a team set out to learn more about it.[^1] Using data from the Planck satellite survey, they analyzed the B-mode polarization using a new method that cuts down on background noise. They were able to measure a small shift in the polarization, known as cosmic birefringence.
It's possible that the observed shift is just due to systematic errors in their measurement, but the team determined that the effect is real to 99.2% likelihood. That isn't high enough to confirm the effect, but it is high enough to merit further study. If the effect is confirmed, it could point to a new understanding of dark matter.

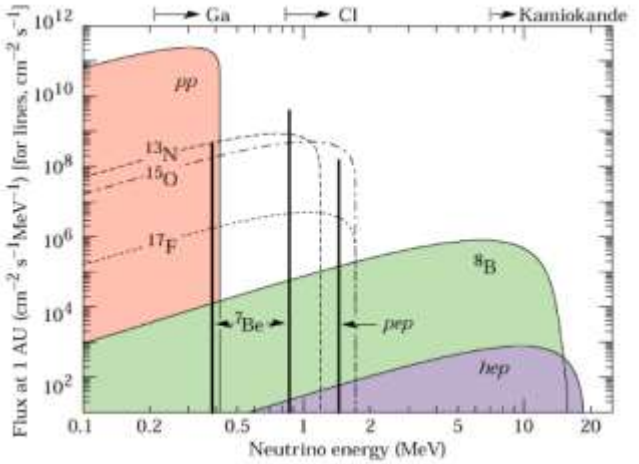
Is this a left hand or a mirror image of a right hand? Credit: Siora Photography (@siora18)
Cosmic birefringence would point to a lack of symmetry known as parity. When matter has parity, an object and its mirror image behave in the same way. For example, a person's left and right hands are mirror images and can move in the same way, thus they have parity. Our hearts are on the left, not the right, thus they violate parity. Regular matter is symmetrical in the way it interacts with CMB light, so it doesn't cause cosmic birefringence. But perhaps dark matter does. This would be a new effect not seen with dark matter and would point to physics beyond the standard model.
It's still too early to tell whether this is a new clue for dark matter. Other phenomena such as early cosmic inflation could also induce B-mode polarization in CMB light. But this study shows the effect can be measured, and that gives us hope that we will one day understand it.
Reference: Minami, Yuto, and Eiichiro Komatsu. "New Extraction of the Cosmic Birefringence from the Planck 2018 Polarization Data." *Physical Review Letters* 125.22 (2020): 221301.

Neutrinos prove the Sun is doing a second kind of fusion in its core

Like all stars, our Sun is powered by the fusion of hydrogen into heavier elements. Nuclear fusion is not only what makes stars shine, it is also a primary source of the chemical elements that make the world around us. Much of our understanding of stellar fusion comes from theoretical models of atomic nuclei, but for our closest star, we also have another source: neutrinos created in the Sun's core.
Whenever atomic nuclei undergo fusion, they produce not only high energy gamma rays but also neutrinos. While the gamma rays heat the Sun's interior over thousands of years, neutrinos zip out of the Sun at nearly the speed of light. Solar neutrinos were first detected in the 1960s, but it was difficult to learn much about them other than the fact that they were emitted from the Sun. This proved that nuclear fusion occurs in the Sun, but not the type of fusion.



The CNO cycle kicks in at higher temperatures. Credit: RJ Hall
According to theory, the dominant form of fusion in the Sun should be the fusion of protons that produces helium from hydrogen. Known as the pp-chain, it is the easiest reaction for stars to create. For larger stars with hotter and more dense cores, a more powerful reaction known as the CNO-cycle is the dominant source of energy. This reaction uses hydrogen in a cycle of reactions with carbon, nitrogen, and oxygen to produce helium. The CNO cycle is part of the reason why these three elements are among the most abundant in the universe (other than hydrogen and helium).
In the past decade neutrino detectors have become much for efficient. Modern detectors are also able to detect not just the energy of a neutrino, but also its flavor. We now know that the solar neutrinos detected from early experiments come not from the common pp-chain neutrinos, but from secondary reactions such as boron decay, which create higher energy neutrinos that are easier to detect. Then in 2014, a team detected low-energy neutrinos directly produced by the pp-chain. Their observations confirmed that 99% of the Sun's energy is generated by proton-proton fusion.



The energy levels of various solar neutrinos. Credit: HERON, Brown University
While the pp-chain dominates fusion in the Sun, our star is large enough that the CNO cycle should occur at a low level. It should be what accounts for that extra 1% of the energy produced by the Sun. But because CNO neutrinos are rare, they are difficult to detect. But recently a team successfully observed them.
One of the biggest challenges with detecting CNO neutrinos is that their signal tends to be buried within terrestrial neutrino noise. Nuclear fusion doesn't occur naturally on Earth, but low levels of radioactive decay from terrestrial rocks can trig-

ger events in a neutrino detector that are similar to CNO neutrino detections. So the team created a sophisticated analysis process that filters the neutrino signal from false positives. Their study confirms that CNO fusion occurs within our Sun at predicted levels.
The CNO cycle plays a minor role in our Sun, but it is central to the life and evolution of more massive stars. This work should help us understand the cycle of large stars, and could help us better understand the origin of the heavier elements that make life on Earth possible.
Reference: The Borexino Collaboration. "Experimental evidence of neutrinos produced in the CNO fusion cycle in the Sun." *Nature* 587 (2020): 577

ESA Is Going To Spend $102 Million To Remove a Single Piece of Space Junk

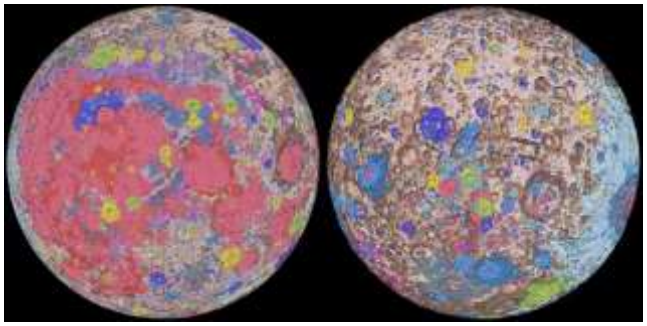
How much would you be willing to spend to remove a piece of space debris? Does $102 million sound like enough? That is how much a contract between the European Space Agency (ESA) and a Swiss start-up named ClearSpace SA is worth, and the entire contract is to simply remove a single piece of space debris.

Admittedly it is a rather large piece of debris – the Vega Secondary Payload Adapter (Vespa) payload adapter weighs in at 112 kilograms (247 pounds). It was originally launched to release a satellite back in 2013, and since then has been aimlessly drifting around the Earth, like so much other derelict space junk. This type of contract is also the first of its kind, and much of the cost of the project is devoted to developing as yet untested technology. Any technology that can directly deal with space junk is well worth the investment.
That space junk could potentially cause huge headaches for craft trying to leave Earth's gravity well, even possibly causing a catastrophic series of events known as Kessler Syndrome. Before the situation gets to that tipping point, numerous teams have begun development on technologies to capture or deorbit space junk. The contract with ClearSpace is just the first of many such contracts that will be necessary in order to ensure that we will continue to have access.
Kurzgesagt video exploring the impact of space debris.
Credit: Kurzgesagt Youtube
Interestingly, even with a contract valued at 9 figures, ClearSpace will still need outside investment in order to cover the full mission cost. The company, which is a spin-off of the Ecole Polytechnique Federale de Lausanne (EPFL), will also be heavily engaged with experts at ESA to help plan and execute on this critical mission. If something goes awry, a failed mission could exacerbate the problem of space debris rather than help to solve it.
Video showing CleanSpace One – ClearSpace's technology under development
Credit: EPFL Youtube
The technology that Clearspace plans to use is a net that collapses onto satellites. Several other companies have various different technologies under development, including the RemoveDEBRIS consortium in the UK and Astroscale out of Japan. Whichever of these technologies proves to be the most effective, it will require massive scale-up in order to address the size of this growing problem. So expect to see much larger contract amounts for space debris clean up in the not-to-distant future.

A new way to map out dark matter is 10 times more precise than the previous-best method

Astronomers have to be extra clever to map out the invisible dark matter in the universe. Recently, a team of researchers have improved an existing technique, making it up to ten times better at seeing in the dark.
Dark matter is frustratingly difficult to measure. It's completely invisible: it simply doesn't interact with light (or normal matter) in any way, shape, or form. But we know that dark matter exists because of its gravitational influence on everything around it – including the normal matter that makes up stars and galaxies.
As an example of this, take a look at gravitational lensing. A massive object, whether made of dark or normal matter, will bend the path of any light that passes close by. It's usually an incredibly tiny effect, but definitely measurable. We can see lensing of starlight around the sun, for example, which is how we knew that Einstein's theory of general relativity must be correct.
When light from a very distant galaxy passes through or a near a slightly-less-distant massive object, like a galaxy cluster, that light gets bent. We can use that distortion to measure the amount of dark matter in the galaxy cluster, and is one of our primary ways of mapping dark matter in the universe.
But we usually don't get this sort of lucky alignment, so instead we have to turn to a different technique: *weak* gravitational lensing. To make this work, astronomers take a survey of a whole slew of galaxies and look for tiny little distortions in each one. Individually, it's not much, but taken together it can provide a map of a large region of dark matter.
Recently, a team of astronomers improved on this idea by adding in the rotation of the observed galaxies, as reported in a recent paper published in the *Monthly Notices of the Royal Astronomical Society*.
Since we know how galaxies ought to rotate, we can combine the distortions in their shapes with the distortions in their internal movements to get a lot more bang for the observational buck, yielding a technique to map dark matter up to ten times more powerful than shapes alone.

The Moon has Resources, but Not Enough to Go Around



It's no secret that in this decade, NASA and other space agencies will be taking us back to the Moon (to stay, this time!) The key to this plan is developing the necessary infrastructure to support a sustainable program of crewed exploration and research. The commercial space sector also hopes to create lunar tourism and lunar mining, extracting and selling some of the Moon's vast resources on the open market.
Ah, but there's a snag! According to an international team of scientists led by the Harvard & Smithsonian Center for Astrophysics (CfA), there may not be enough resources on the Moon to go around. Without some clear international policies and agreements in place to determine who can claim what and where, the Moon could quickly become overcrowded, overburdened, and stripped of its resources.

Arecibo's Damage is so Serious and Dangerous, They're Just Going to Scrap the Observatory Entirely

This past summer, the Arecibo Observatory suffered major damage when an auxiliary cable that supports the platform above the telescope broke and struck the reflector dish. Immediately thereafter, technicians with the observatory and the University of Central Florida (UCF) began working to

stabilize the structure and assess the damage. Unfortunately, about two weeks ago (on Nov. 6th), a second cable broke causing even more damage.

Following a thorough review, the U.S. National Science Foundation (NSF) announced that the observatory cannot be stabilized without risking the lives of construction workers and staff at the facility. As such, after 57 years of faithful service and countless contributions to multiple fields of astronomy, the NSF has decided to commence plans for decommissioning the Arecibo Observatory.
This decision came shortly after the NSF evaluated assessments from a number of independent experts and companies to determine the cause of the structural failures and recommend steps for effecting repairs. These assessments indicated that the support cables are no longer capable of carrying the loads required of them and that the telescope structure is in danger of a catastrophic failure.

Damage at the Arecibo Observatory in August, 2020. Credit: NSF/NAIC

In addition, several assessments stated that any attempt to make repairs could put the lives of workers in danger. They also found that even if the repairs were successful, the structure would still be suffering from long-term stability issues. As Director Sethuraman Panchanathan said in an NSF statement:
"NSF prioritizes the safety of workers, Arecibo Observatory's staff and visitors, which makes this decision necessary, although unfortunate. For nearly six decades, the Arecibo Observatory has served as a beacon for breakthrough science and what a partnership with a community can look like. While this is a profound change, we will be looking for ways to assist the scientific community and maintain that strong relationship with the people of Puerto Rico."
After the first incident, engineering teams wasted no time coming up with an emergency stabilization plan of the auxiliary cable system. Despite the damage the broken auxiliary cable caused to the Gregorian Dome, the supporting structure, and the 30-meter (100 foot) gash it left in the reflector dish, the engineers were prepared to commence repairs by Nov. 9th (three days after the second cable broke).
The observatory was even arranging for the delivery of two replacement auxiliary cables (and two temporary ones) when the second failure occurred. This time, it was a main cable that broke, indicating that the structural problems extended to all the cable networks that connect the main dish to the instrument platform above it.

Aerial view of the NSF"s Arecibo Observatory in Puerto Rico. Credit: NAIC

According to Ralph Gaume, director of NSF's Division of Astronomical Sciences, this was the decisive factor in the decision to decommission:
"Leadership at Arecibo Observatory and UCF did a commendable job addressing this situation, acting quickly and pursuing every possible option to save this incredible instrument. Until these assessments came in, our question was not if the observatory should be repaired but how. But in the end, a preponderance of data showed that we simply could not do this safely. And that is a line we cannot cross."
Engineering assessments quickly followed that indicated that this 7.62 cm (3-inch) main cable was stressed to about 60% of its minimum tolerance (during calm weather) when it broke. Inspections of the other cables revealed new wire breaks on some of the other main cables and evidence of significant slippage at several sockets holding the remaining auxiliary cables.
These findings confirmed that both the main and auxiliary support cables were weakened more than originally projected. This led the engineering teams to conclude that decommission and demolition were the only option. John Abruzzo was the manager of the assessment made by Thornton Thomasetti, one of the structural engineering companies evaluating the observatory. As he summarized in their recommendation for action letter:
"Although it saddens us to make this recommendation, we believe the structure should be demolished in a controlled way as soon as pragmatically possible. It is therefore our recommendation to expeditiously plan for decommissioning of the observatory and execute a controlled demolition of the telescope."

The Arecibo Observatory, The Arecibo Legacy Fast ALFA Survey. Credit: egg.astro.cornell.edu

The NSF's plan for decommissioning the observatory would involve shutting down the 305 m (100 ft) telescope

while safely preserving the other parts of the observatory that could be damaged or destroyed in the event of a catastrophic failure. In short, they hope to retain as much of the remaining infrastructure as possible so that it can still be of use for future research and educational purposes.
The decommissioning process is complex and requires that the NSF, UCF, and all participatory institutions comply with a series of legal, environmental, safety, and cultural requirements. In the meantime, the NSF has commenced a high-resolution photographic survey using aerial drones and is considering conducting a forensic evaluation of the broken cable (assuming it can be done safely).
When all necessary preparations are finished, the telescope would be subject to a controlled disassembly. Once that is done, the NSF intends to restore operations to Arecibo's LIDAR facility, its visitor center, and the offsite Culebra meteorological facility. The analysis and cataloguing of archival data collected by the telescope will also continue.
While the decommissioning of Arecibo is certainly a sad development, it's clearly necessary at this juncture. Said Michael Wiltberger, head of NSF's Geospace Section:
"Over its lifetime, Arecibo Observatory has helped transform our understanding of the ionosphere, showing us how density, composition and other factors interact to shape this critical region where Earth's atmosphere meets space.
"While I am disappointed by the loss of investigative capabilities, I believe this process is a necessary step to preserve the research community's ability to use Arecibo Observatory's other assets and hopefully ensure that important work can continue at the facility."

Artist's impression of the Arecibo Message, the coded message intended for extraterrestrials sent in 1974 from the Arecibo Observatory. Credit and Copyright: Danielle Futselaar
Throughout its 57 years of service, the Arecibo Observatory was the world's premier radio telescope and one of the most iconic astronomical facilities in the world. Until the completion of the Five hundred meter Aperture Spherical Telescope (FAST) in China, it was also the largest radio observatory in the world. It's accomplishment are unparalleled and include a number of firsts.
These include the confirmation of neutron stars, detecting the first binary pulsar, the first-millisecond pulsar, and the first exoplanets. The facility is also home to the Planetary Radar Project which (with support provided by NASA's Near-Earth Object Observations Program) tracks and characterizes near-Earth objects (NEOs). In addition, the facility has also played an important role in the Search for Extraterrestrial Intelligence (SETI).

Aside from providing the source data for SETI@home and the SETI Institute's Project Pheonix, the observatory is also one of the few installations in the world to actively send an encoded message to space intended for extraterrestrials. – aka. the Arecibo Message. She's done so much in her lifetime, and she will continue to contribute in retirement.

So long, Arecibo! You will be missed!

Scientists Have Re-Analyzed Their Data and Still See a Signal of Phosphine at Venus. Just Less of it

In September, an international team announced that based on data obtained by the Atacama Millimeter-submillimeter Array (ALMA) in Chile and the James Clerk Maxwell Telescope (JCMT) in Hawaii, they had discovered phosphine gas (PH_3) in the atmosphere of Venus. The news was met with its fair share of skepticism and controversy since phosphine is considered a possible indication of life (aka. a biosignature).

Shortly thereafter, a series of papers were published that questioned the observations and conclusions, with one team going as far as to say there was "no phosphine" in Venus' atmosphere at all. Luckily, after re-analyzing the ALMA data, the team responsible for the original discovery concluded that there is indeed phosphine in the cloud tops of Venus – just not as much as they initially thought.

In the original study, which was published in the Sept. 14th issue of *Nature Astronomy*, the team presented findings from ALMA and the JCMT that indicated the presence of PH_3 around Venus' cloud deck. On Earth, phosphine is part of the phosphorus biochemical cycle and is likely the result of phosphate reduction in decaying organic matter. On Venus, there are no known chemistry and photochemical pathways for its creation.

This artistic impression depicts Venus. Astronomers at MIT, Cardiff University, and elsewhere may have observed signs of life in the atmosphere of Venus. Credits: ESO/M. Kornmesser & NASA/JPL/Caltech
The only non-organic (aka. abiotic) mechanism for the production of phosphine involves high temperatures and pressures, which are common within the atmospheres of gas giants. In fact, phosphine has been detected in Jupiter's atmosphere, where it forms as a result of planet-sized convective storms that generate tremendous amounts of energy. The only other explanation was bacteria floating in Venus' cloud deck.
"Spurious"

In one study, which was led by researchers from NASA God-

dard and appeared in a *Nature Astronomy "Matters Arising"* article (Oct. 26th, 2020), also cast doubt on the analysis and interpretation of the ALMA and JCMT datasets. Here, the research team indicated that the spectral data that was interpreted as phosphine (PH_3) was actually too close to sulfur dioxide (SO_2), which is common in Venus atmosphere.

According to another study that was led by Leiden University (Nov. 17th, 2020, *Astronomy & Astrophysics*), the spectral data obtained by ALMA could be explained by the presence of compounds other than phosphine gas. From this, they concluded that there "no statistically significant detection of phosphine" in Venus' atmosphere and that the previous results were, in fact, "spurious."

Jane Greaves, who led the discovery team (and is an astronomer at Cardiff University, UK), claims that they were motivated to reexamine their original conclusions because the original ALMA data contained a "spurious signal" that could have thrown off their results. When the corrected ALMA data was posted on Nov. 16th, Greaves and her colleagues ran a fresh analysis and posted it ahead of peer review on arXiv.

Artist's impression of the surface of Venus. Credit: Greg Prichard

This is the team's first public response to the criticisms that were made in the wake of their original findings. Their revised findings were also presented at a meeting of the Venus Exploration Analysis Group (VEXAG), a NASA community forum, that took place on Nov. 17th. While they have since indicated that their results are "tentative," they remain confident about the presence of phophene in Venus' atmosphere.

So… Less?

According to Greaves and her colleagues, the ALMA data demonstrated a spectral signature that cannot be explained by SO_2 anything other than the compound phosphene. This, they claim, is further bolstered by the JCMT spectra that indicated the chemical fingerprints of phosphine. Based on the new ALMA data, the team estimates that phosphine levels average at about 1 ppb – about one-seventh of their earlier estimate.

These levels, they indicate, likely peak at 5 parts per billion (ppm) and vary over time and depending on location. If true, this situation is similar to what scientists have observed on Mars, where methane levels wax and wave over the course of a Martian year and vary from place to place.

In addition to criticism, supporting evidence was also inspired by the team's original paper – which was also presented at VEXAG on Nov. 17th.

Inspired by the possibility, biochemist Rakesh Mogul of the California State Polytechnic University in Pomona and his colleagues re-examined data from NASA's Pioneer Venus mission. In 1978, this missions studies Venus' cloud layer using a probe that it dropped into the atmosphere. Based on their re-analysis of the data, Mogul and his colleagues found evidence of phosphorus.

Artist's impression of the Pioneer Venus Orbiter. Credit: NASA

This could evidence of phosphine or some other phosphorus compound, though Mogul and his team believe phosphine is the most likely candidate. Regardless, several scientists argued at VEXAG that a modest level of even 1 ppm phosphine cannot be attributed to processes like volcanism or lightning. There was also the recent announced that the amino acid glycine was discovered in Venus' atmosphere, another potential biomarker.

What's Next?

For obvious reasons, finding evidence of phosphine on Venus would be very appealing. In the past, scientists have speculated that life could exist in the planet's cloud deck, where temperatures are stable enough that extremophiles could survive. If this compound is confirmed in Venus' atmosphere, it would indicate that Venus is capable of supporting extreme lifeforms in niche habitats.

In any case, these results demand further investigation and have led to renewed proposals for missions to Venus', possibly in the form of a balloon or an airship. In the meantime, Greaves and other researchers hope to have more time with Earth-based telescopes (including ALMA) to confirm the presence of phosphine. Whether this compound exists there or not, Venus is still a bundle of mysteries just waiting to be solved!

E Mails Viewings Logs and Images from Members.

Hi Andy,
I hope you are well.
Here are my submissions for the December 2020 WAS Newsletter.

05/11/2020
82% Lit Waning Gibbous Moon

Canon SX50HS 1200mm, ISO 80, F8, 1/125 sec
80 raw images converted to tiff in Canon DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.

06/11/2020
Pleiades and Hyades Rising

Canon G16, 28mm, ISO 800, F1.8, 8 sec.

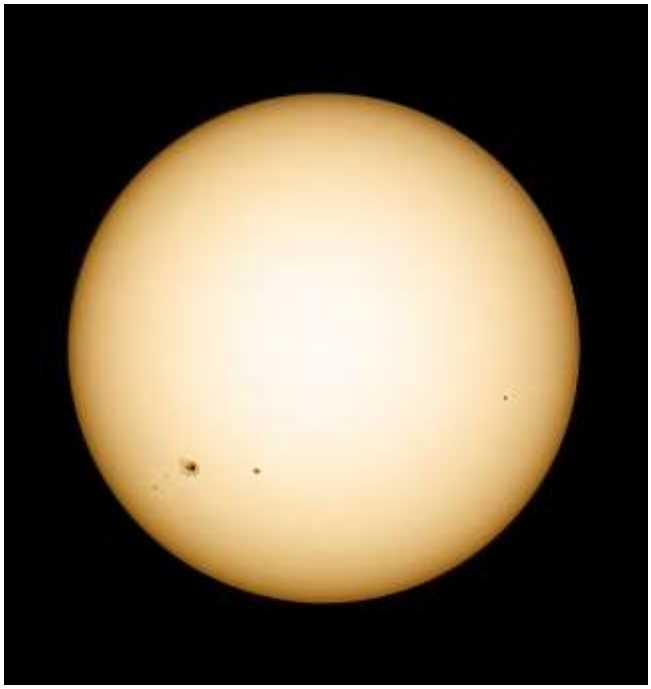
18/11/2020
Saturn, Jupiter and 17% Waxing Crescent Moon

Canon G16

25/11/2020
82% Lit Waxing Gibbous Moon

Canon SX50HS 1200mm, ISO 80, F8, 1/125 sec

35 raw images converted to tiff in Canon DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.
26/11/2020
Sunspot AR2785 and AR2786



Canon SX50HS 1200mm, ISO 100, F8, 1/1600 sec
80 raw images converted to tiff in Canon DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo and Photoshop.
Clear Skies,
John

Hi Andy,

No viewing log this month due to lockdown!

Two pictures instead.

Lunar X & V.

Tech details: Canon 70 camera with 150-600 mm lens attached set at 600 mm with an ISO of 200, aperture of 6.3 and 1/125 of a second shutter speed.

ISS over moon and Mars.

Tech details: Canon 60Da camera with 10-22 mm lens set at 11 mm with an ISO of 125, aperture of 5.6 and 20 second shutter speed.

Both pictures taken with a Manfrotto tripod.

Hopefully astronomy can start soon and I can get back out viewing?

Peter

A very nippy pyjama log.

I did put on a t-shirt,

10:15 to 10:40pm

The glare around the Moon told me it was not going to be perfect transparency this evening so used 15x80 Vixen binoculars and avoided the Moon until the end. How close can you go. To the lower east Orion was risen, and Betelgeuse showed plenty of colour (sometimes the this mist can enhance perceived colour, and the bluer glow of Rigel. No M78, but across to the dagger the Orion nebular was just visible and the trapezium was about is sight, coming and going as tendrils of mist cover the region.

Up to Taurus, closer to the Moon so orange Aldebaran was visible but nut many of the Hyades, but the Pleiades were surprisingly bright, showing nearly 50 stars. Up to Triangulum, the 4 main stars clearly seen but sign of the Triangulum galaxy. Pegasus and M15 could be seen. Mars very clear.

Moved to the rear to cut moon glow, and Ursa Major is hanging low, and although Mizar and Alcor could be split Mizar B was not clear enough, or the hands not steady. Back towards the Moon, well Capella and the Kids were visible but none of the great open clusters because of the Moon's proximity. So to the West Cygnus was standing out. M39 and M29 seen, and even (just) the ring nebular in Orion, but the dumbbell had gone. Above Deneb, is that a trace of a nebula??? NGC7000? Perhaps at sky limit, visible limit about mag 5 in the best of the sky.

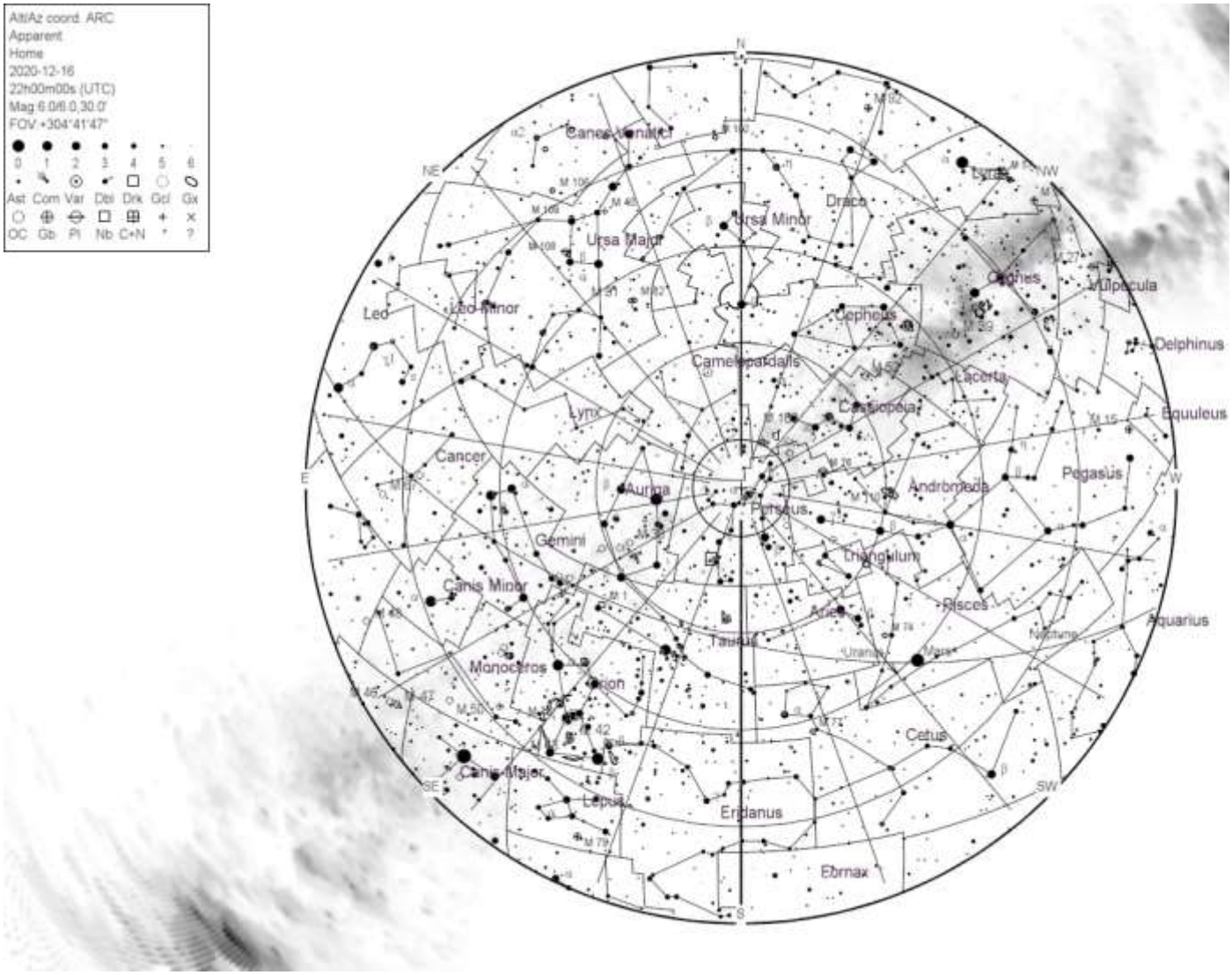
Back to the Moon, 17.5 day phase. Bright, but Aristarchus looking very bright, Tycho's ray system and the big pock marked floor of Clavius, but the best was looking down the terminator, the end or Mare Frigorium at the top (with the rotation angle) but Hercules and Atlas craters at the

end. Down to Mare Serenitas and to the edge Macrobus (is that a relative of a Megabus), Sea of Tranquillity and the dark patch of Sinus Concordiea running to the terminator. Mare Fecundium and inside the dark circle of Mare Nectaris. Then down the terminator to the Hummel/Viscq area of cratering.

Quick, lets get in under the covers…

Apologies for spelling without checks… Andy 3rd November 2020.

WHATS UP, DECEMBER 2020



December 13, 14 - **Geminids Meteor Shower.** The Geminids is the king of the meteor showers. It is considered by many to be the best shower in the heavens, producing up to 120 multicolored meteors per hour at its peak. It is produced by debris left behind by an asteroid known as 3200 Phaethon, which was discovered in 1982. The shower runs annually from December 7-17. It peaks this year on the night of the 13th and morning of the 14th. The morning of the 15th could also be nearly as active this year. The nearly new moon will ensure 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 Gemini, but can appear anywhere in the sky.

December 14 - **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 16:18 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 14 - **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 only be visible in parts of southern Chile and southern Argentina. A partial eclipse will be visible in most parts of southern South America, the southeastern Pacific Ocean and the southern Atlantic Ocean.

December 21 - **December Solstice.** The December solstice occurs at 10:02 UTC. The South Pole of the earth will be tilted toward the Sun, which will have reached its southernmost position in the sky and will be directly over the Tropic of Capricorn at 23.44 degrees south latitude. This is the first day of winter (winter solstice) in the Northern Hemisphere and the first day of summer (summer solstice) in the Southern Hemisphere.

December 21 - **Rare Conjunction of Jupiter and Saturn.** A conjunction of Jupiter and Saturn will take place on December 21. This rare conjunction of these two planets is known as a great conjunction. The last great conjunction occurred in the year 2000. The two bright planets will appear only 7 arc minutes of each other in the night sky. They will be so close that they will appear to make a bright double planet. Look to the west just after sunset for this impressive and rare planetary pair.

December 21, 22 - **Ursids Meteor Shower.** The Ursids is a minor meteor shower producing about 5-10 meteors per hour. It is produced by dust grains left behind by comet Tuttle, which was first discovered in 1790. The shower runs annually from December 17-25. It peaks this year on the the night of the 21st and morning of the 22nd. The first quarter moon should set just after midnight leaving dark skies for what could be a good show. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Ursa Minor, but can appear anywhere in the sky.

December 30 - **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 03:30 UTC. This full moon was known by early Native American tribes as the Cold Moon because this is the time of year when the cold winter air settles in and the nights become long and dark. This moon has also been known as the Long Nights Moon and the Moon Before Yule.

Clear skies, Andy

Observing Notes - December 2020

The Twins & Their Siblings!

This month we take a look at Gemini and their sibling .

For December, we turn to the constellation of Gemini (The Twins) with a few open clusters and a planetary nebula to view. Gemini sits to the upper left of Orion, its two main stars being Castor (a double star) and Pollux (a multiple system, with their primaries shining at 0.91 and 1.18 respectively.

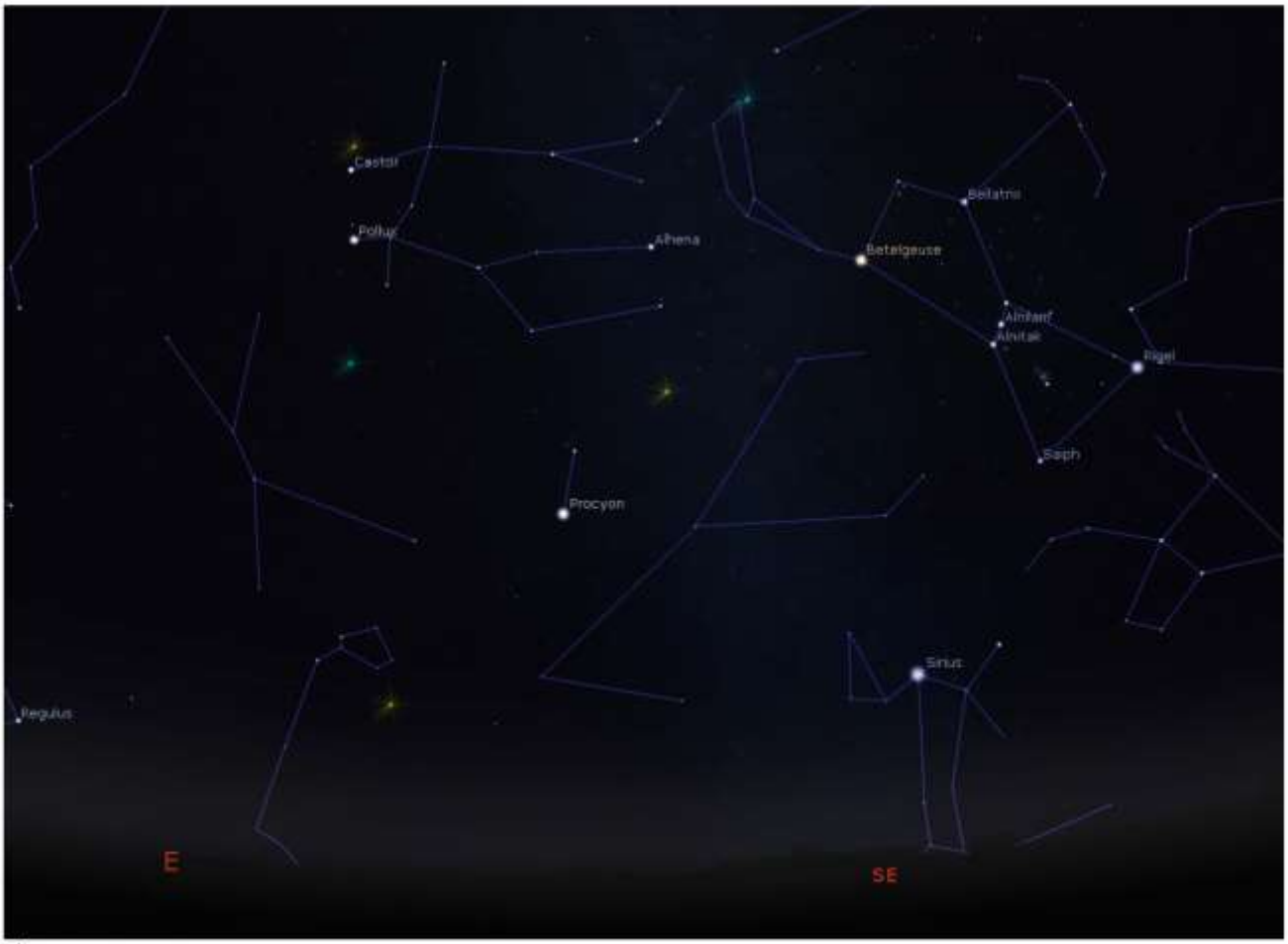
Greek mythology tells us that Gemini is named after the Twins, Castor and Pollux, who were allegedly the sons of Zeus. Inseparable from birth, when one twin died (or was murdered, depending upon which myth you care to read), Zeus placed them both in the sky becoming the constellation Gemini.

Gemini is quite easy to spot rising in the east to south east, with the screenshot below for around 10:30 pm on 12th December. If you locate Betelgeuse then look to the left you should be able to spot Castor and Pollux and then trace your way to the other main stars, Wasat, Mebsuta and Propus to guide us along the way.

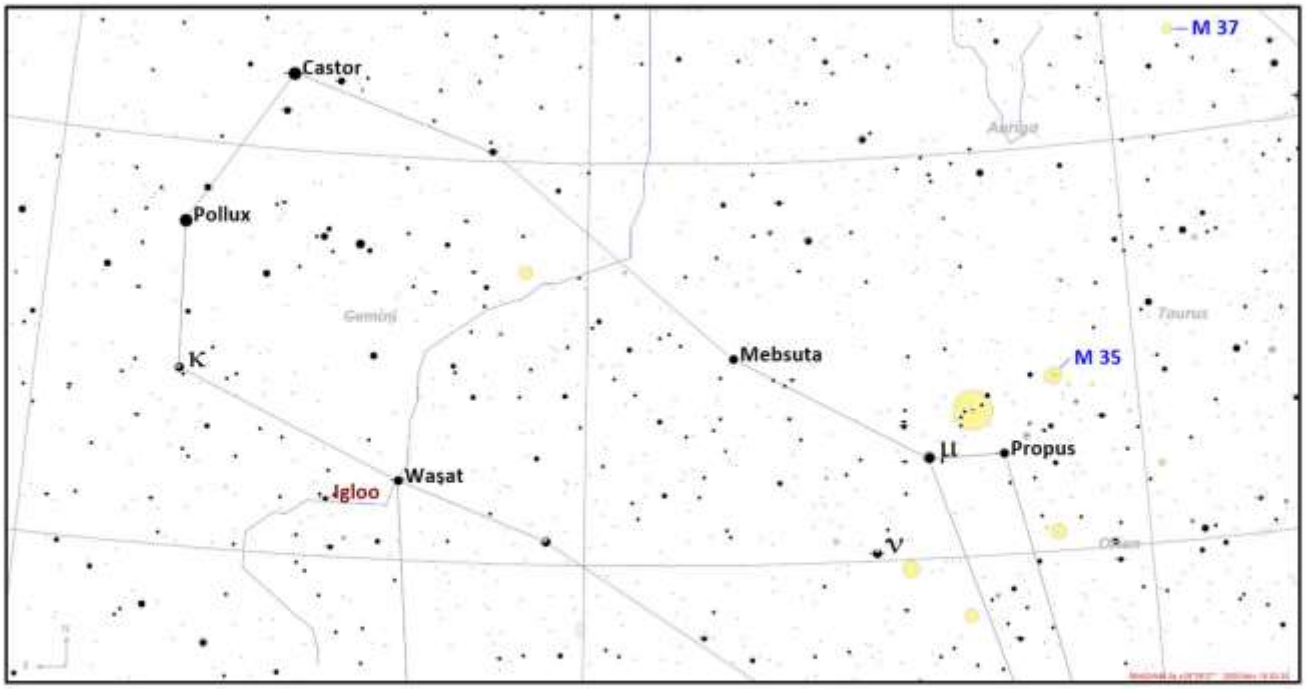
Messier 35

M35 is probably the most famous cluster of the winter sky and my favourite. The cluster is located some 2,800 light years away and is around 22 light years in diameter. We see it as covering an apparent area approximately the same as the full moon. M35 comprises around 20 stars of 10th magnitude, increasing to 120 of 13th magnitude, although once you reach 21st magnitude this gives some 2700 stars that may belong to the cluster. It is also comparatively young, having been formed some 100 to 150 million years ago.

Under dark skies, you may be able to make out M35 with the naked eye, but engage binoculars and you are amply rewarded by being able to trace the outer chains of stars. A telescope gives many happy hours of observing this cluster. For my own



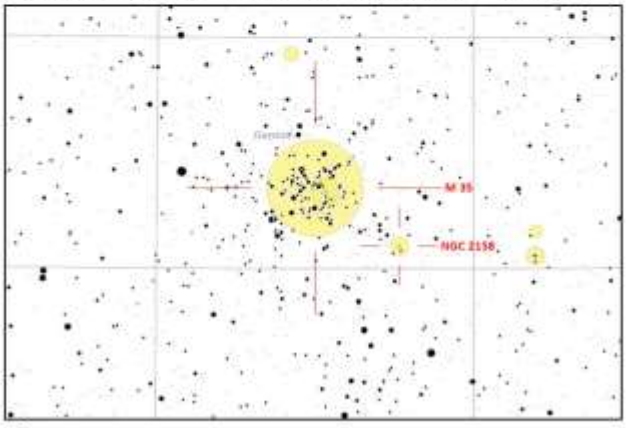
▲ Looking East to Gemini



Detail of Gemini and location of Messier 35

observations, using my 8" reflector, I have spent ages just following the trails of stars, the way they seem to interlink and create streamers, trails and chains. I normally start with a low power such as 32mm and just trace along the links and streamers, then add a Barlow to double the magnification, which fills my field of view. I perceive the stars as blue throughout; although there are some yellow and orange giants within the cluster.

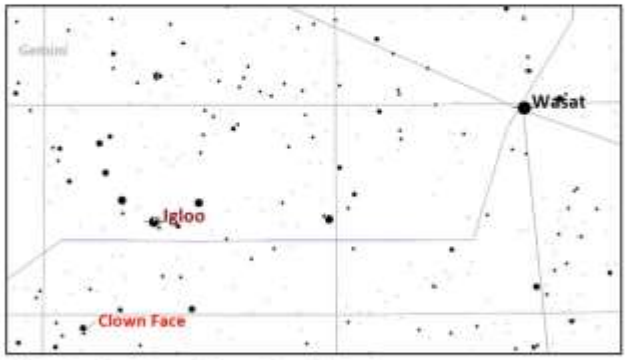
An added bonus is that in the immediate vicinity is NGC 2158, another open cluster, but rather more compact. Lying some 12,000 light years away, it is far older than M35 being estimated at just over 1 billion years old. Observationally a small telescope shows a nebulous patch, and an aperture of 10" to 12" is needed to resolve the brightest stars.



M35 & NGC 2158

Eskimo Nebula

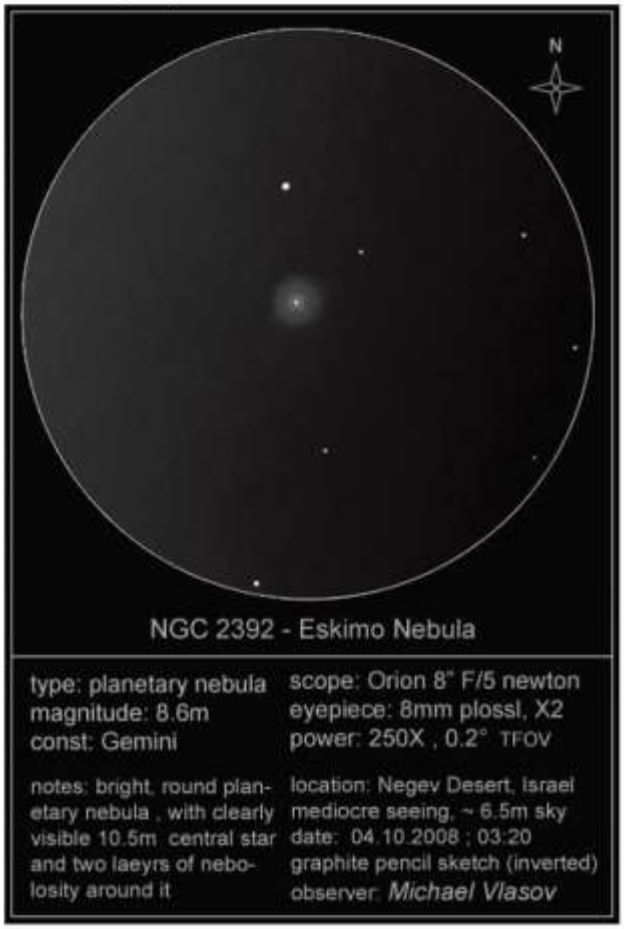
The Eskimo Nebula, or the Clown Face, or NGC 2392 to give it its proper designation, is a planetary nebula that is a good target for modest telescopes. I remember spotting this in my 6" reflector some years ago and found it by locating an arc of stars starting from Wasat. The Eskimo is so called due to its resemblance to a face on an Eskimo hood. I can't say I have seen this effect but I have not observed the Eskimo for a while and not with my bigger telescope.



Finder for Eskimo (Clown Face) Nebula

To locate it by star hopping, locate Wasat, which I think of as the waist of Pollux, then look for the arc of stars known as the Igloo, which you

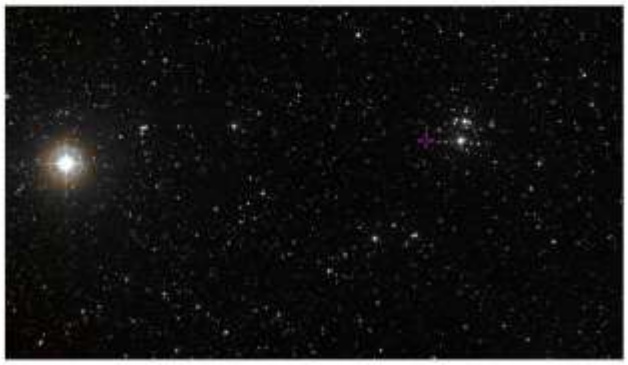
can spot it in the finder scope. This is a good sketch of the nebula by Michael Vlasov at http://www.deepskywatch.com

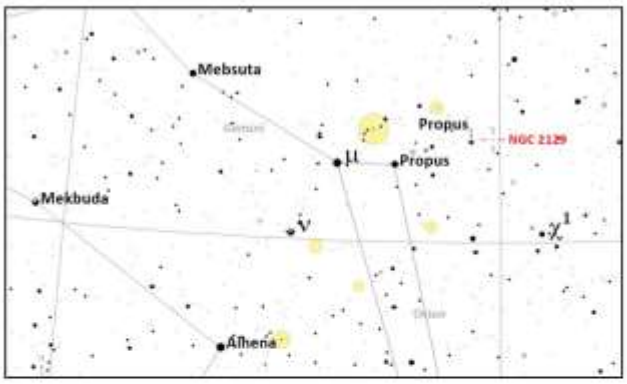


▲ Eskimo Nebula sketch by Michael Vlasov

NGC 2129

This open cluster lies a little beyond the star 1 Geminorum. Lying some 7,000 light years way, it is a is a very young cluster estimated at 10 million years old. I first observed this 7 years ago and I noted it as a "small Auriga shaped open cluster, 3 bright stars in a right angle with a small triangular



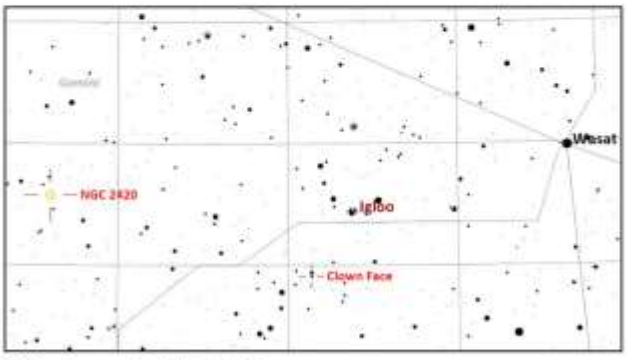


"hat"; I got more hints of stars in this cluster."

NGC 2420

NGC 2420 is a beautiful, yet subtle open cluster not far from The Eskimo Nebula. I found fairly easily starting from from Wasat, moving across to the Igloo and then to 2420. My notes remind me that "Its shape suggested a lazy X and was just visible in my 9 x 50 finder, and easy with 50x and resolvable at 100x."

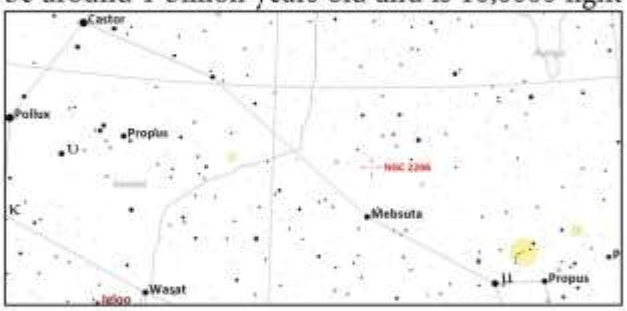
▲ NGC 2420



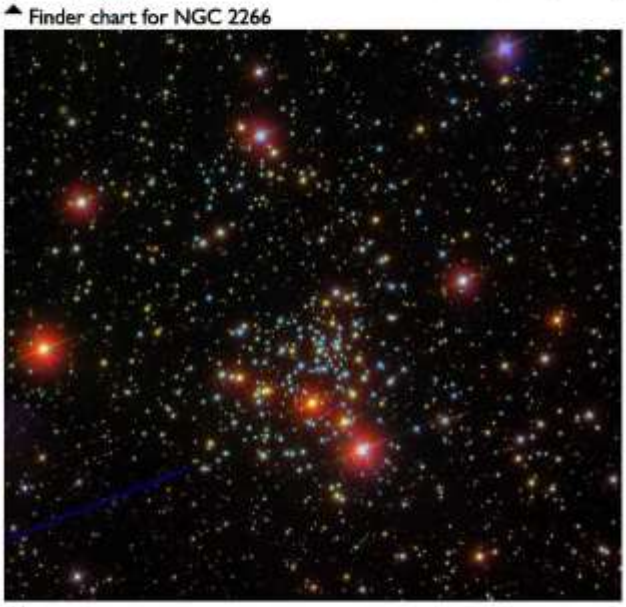
▲ Finder map for NGC 2420

NGC 2266

NGC 2266 lies near Mebsuta, the waist (to me) of Castor. It is a triangular cluster which shines at magnitude 9.5. It is old for a cluster estimated to be around 1 billion years old and is 10,0000 light



Finder chart for NGC 2266



NGC 2266

years distant. I star hopped from Mebsuta and spotted with 50x, but upping to 100x shows line of bright curved stars across top, with fainter triangle of stars tapering to a point.

Geminids

This year, the Geminids coincides with the New Moon offering ideal observing conditions. This shower is one of the most active and appear to radiate near Castor. The source is a stream of debris left behind by the asteroid 3200 Phaethon, distinguishing it as one of the major showers not originating from a comet. The shower peaks on 13/14 December

Comets

We have Comet Atlas moving through Auriga during December. I have not yet seen it myself as the clouds have been ever-present, but it should be easy to spot as the moon moves out of the sky.

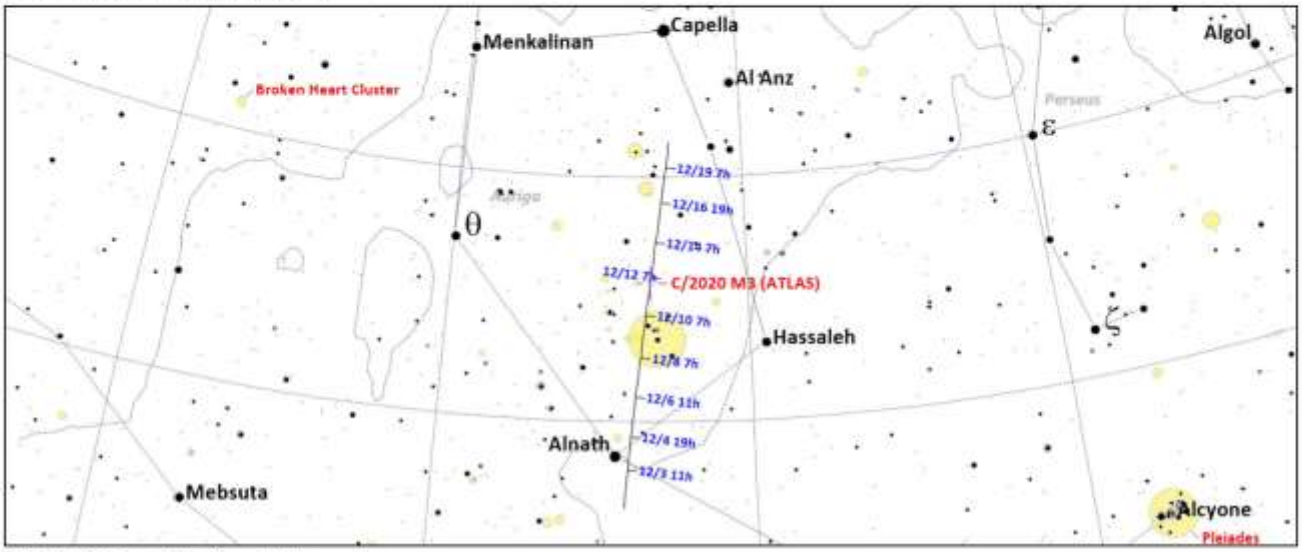
Planets

Mars continues its path across the sky, sinking in the south west around 23:00. Jupiter and Saturn move closer together in the early evening, culminating in a "Great Conjunction"; the last time these two planets appeared so close was on July 16, 1623, when they were only 5 arc minutes apart, this year they will be 6.1 arc minutes of each other.

Uranus lies in Aries and form a nice line taking in the Moon and Mars on the 21st. Early risers (07:00 is early for me!) can catch Venus in the south east.

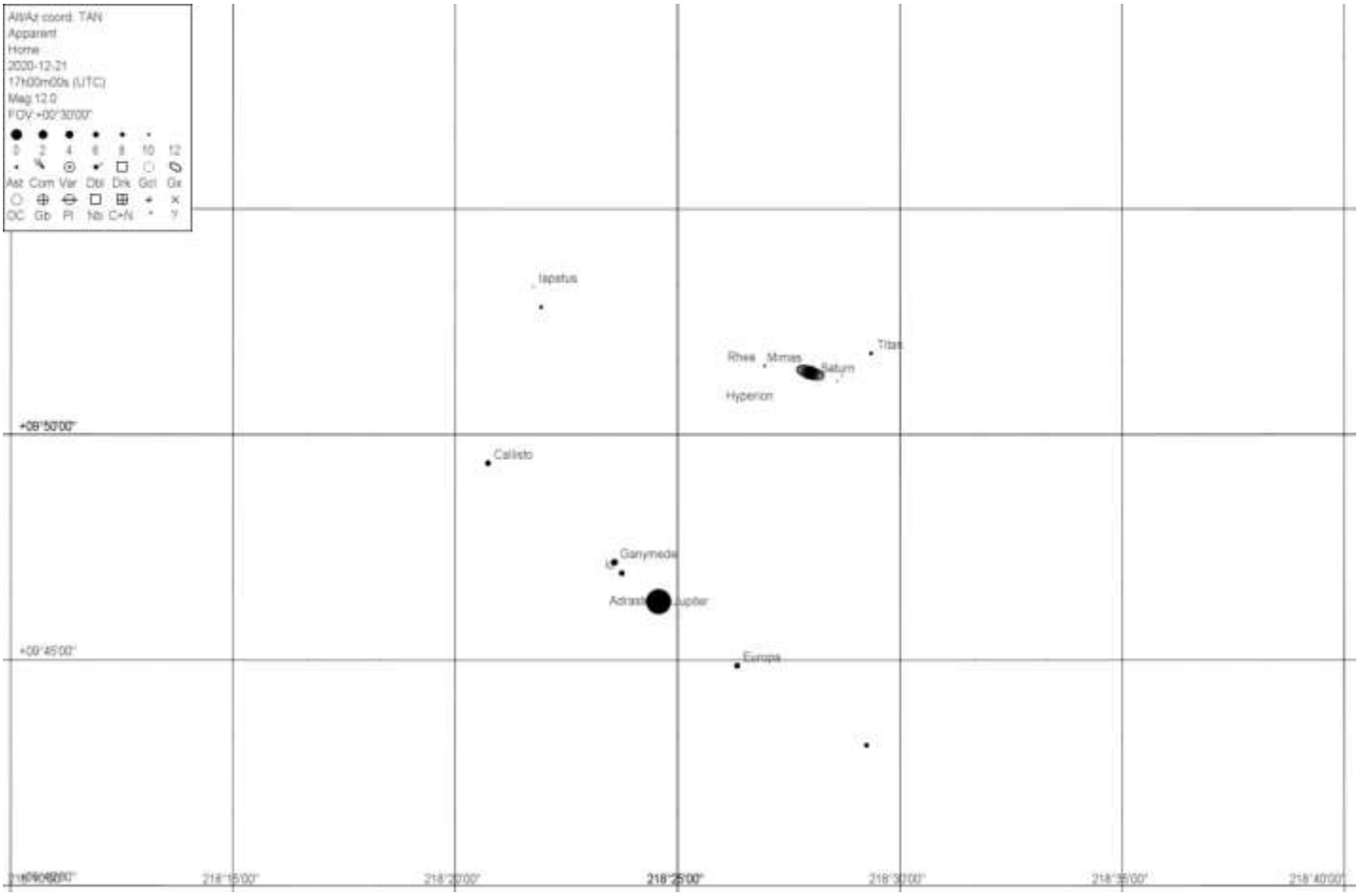
December also sees the Winter Solstice and hopefully towards a better 2021!

Jonathan Gale
WAS Observing Team



Track of Comet Atlas from 1st December

December 21 - **Rare Conjunction of Jupiter and Saturn.** A conjunction of Jupiter and Saturn will take place on December 21. This rare conjunction of these two planets is known as a great conjunction. The last great conjunction occurred in the year 2000. The two bright planets will appear only 7 arc minutes of each other in the night sky. They will be so close that they will appear to make a bright double planet. Look to the west just after sunset for this impressive and rare planetary pair.



Astronomers use the word conjunction to describe meetings of planets and other objects on our sky's dome. They use the term great conjunction to describe meetings of the two biggest worlds in our solar system, mighty Jupiter and the glorious ringed planet Saturn. The next great conjunction of Jupiter and Saturn will be December 21, 2020. That date is, coincidentally, the date of the December solstice. It'll be the first Jupiter-Saturn conjunction since the year 2000, and the *closest* Jupiter-Saturn conjunction since 1623, only 14 years after Galileo made his first telescope. However, that conjunction was only 13 degrees east of the sun (closely following the sun at sunset), and it is considered unlikely that it was noticed by many. The closest *observable* Jupiter-Saturn conjunction before that was as long ago as during medieval times, in 1226! At their closest in December, Jupiter and Saturn will be only 0.1 degree apart. That's just 1/5 of a full moon diameter.

The extra-close Jupiter-Saturn conjunction in 2020 won't be matched again until the Jupiter-Saturn conjunction of March 15, 2080.

But don't wait until December to start watching these worlds. They're visible tonight and every night – near each other for the rest of 2020 – an appealing and mind-expanding sight!

In December, just as Jupiter and Saturn are nearly at their closest, the young moon will sweep past them. From December 16-25, 2020, the 2 will be separated by less than a full-moon diameter, just as the moon is passing close. Don't miss this glorious sight in the western sky after sunset! Jupiter is brighter, outshining Saturn by 12 times. Saturn is respectably bright, shining as brilliantly as a 1st-magnitude star.

At the 2000 great conjunction, 20 years ago, Jupiter and Saturn were near the sun in our sky and difficult to observe.

We're due for a more observable great conjunction, and we'll get one. In November, Jupiter and Saturn are noticeable for their nearness to each other, and they are in the sky when darkness falls.

By December, Jupiter and Saturn will still be easily visible. They'll be, if anything, even more beautiful than now, in the western twilight shortly after sunset.

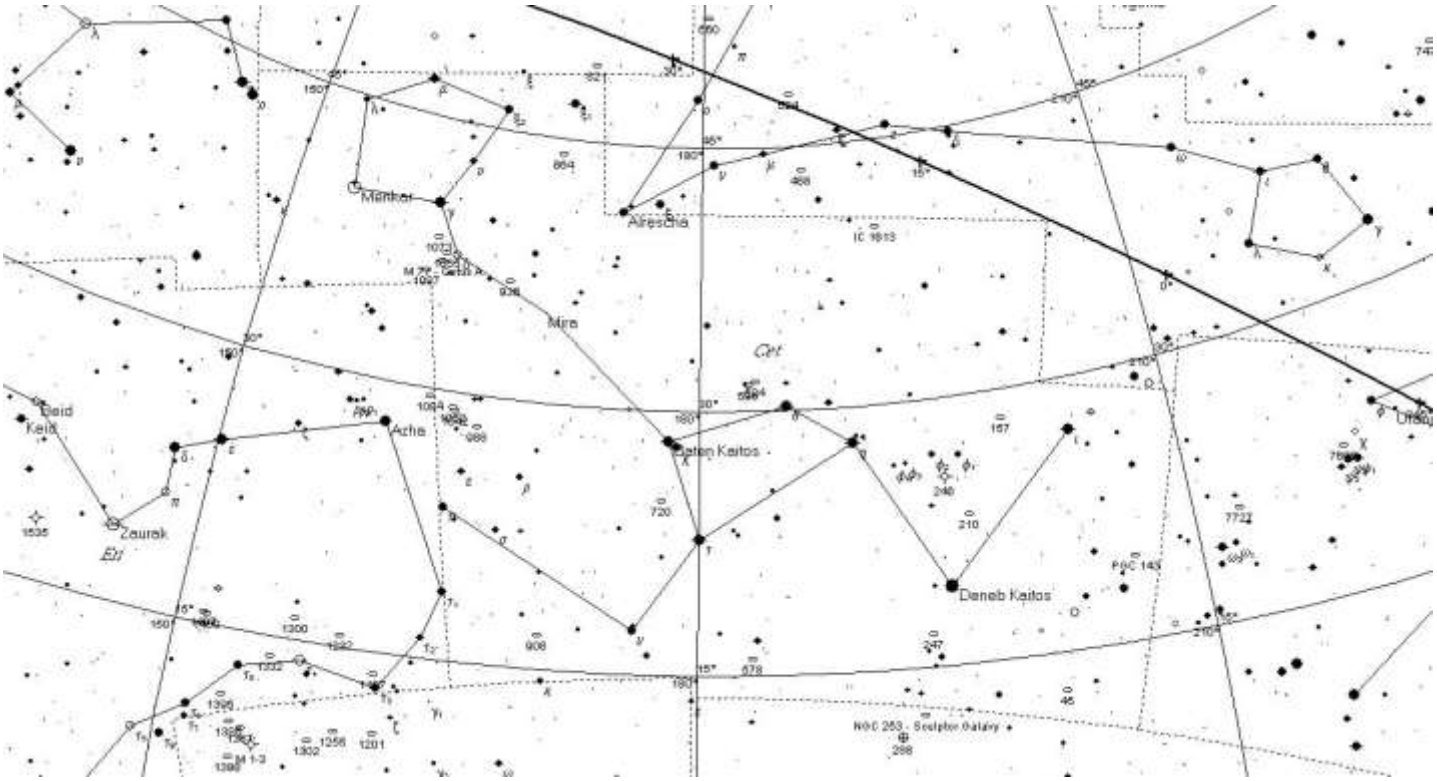
You'll recognize Jupiter and Saturn easily, from now through the end of the year. Jupiter is brighter than any star. Saturn is not as bright as Jupiter, but it's as bright as the brightest stars and shines with a distinctly golden color. Also, Jupiter is near Saturn! Saturn is just to the east of Jupiter on the sky's dome. Unlike the twinkling stars, Jupiter and Saturn both shine steadily.

This month – during the period when the moon swept past Jupiter and Saturn (about November 16 to November 21) – the two gas giant planets are some 3 degrees apart.

Over the coming month – from November 21 to the day of the conjunction itself, December 21 – Jupiter will travel about 6 degrees and Saturn 3 degrees on the sky's dome. That movement will mean that Jupiter bridges the 3-degree gap between itself and Saturn.

Bingo! Great conjunction!

CONSTELLATIONS OF THE MONTH: CETUS



The Cetus Constellation

In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) compiled a list of all the then-known 48 constellations. This treatise, known as the ***Almagest***, would be used by medieval European and Islamic scholars for over a thousand years to come, effectively becoming astrological and astronomical canon until the early Modern Age.

One of these constellations is Cetus, which was named in honour of the sea monster from Greek mythology. Cetus is the fourth largest constellation in the sky, the majority of which resides just below the ecliptic plane. Here, it is bordered by many "watery" constellations – including Aquarius, Pisces, Eridanus, Piscis Australus, Capricornus – as well as Aries, Sculptor, Fornax and Taurus. Today, it is one of the 88 modern constellations recognized by the IAU.

Name and Meaning:

In mythology, Cetus ties in with the legendary Cepheus,Cassiopeia, Andromeda, Perseus tale – for Cetus is the monster to which poor Andromeda was to be sacrificed. (This whole tale is quite wonderful when studied, for we can also tie in Pegasus as Perseus' horse, Algol and the whom he slew to get to Andromeda and much, much more!)

Cetus, as represented by Sidney Hall in this card from Urania's Mirror (1825). Credit: Library of Congress/Sidney Hall

As for poor, ugly Cetus. He also represents the gates to the underworld thanks to his position just under the ecliptic plane. Arab legend has it that Cetus carries two pearl necklaces – one broken and the other intact – which oddly enough, you can see among its faint stars in the circular patterns when nights are dark. No matter what the legends are, Cetus is an rather dim, but interesting constellation!

History of Observation:

Cetus was one of many Mesopotamian constellations that passed down to the Greeks. Originally, Cetus may have been associated with a whale, and is often referred to as the Whale. However, its most common representation is that of the sea monster that was slain by Perseus.

In the 17th century, Cetus was depicted variously as a "dragon fish" (by Johann Bayer), and as a whale-like creature by famed 17th-century cartographers Willem Blaeu and Andreas Cellarius. However, Cetus has also been variously depicted with animal heads attached to an aquatic animal body.

The constellation is also represented in many non-Western astrological systems.In Chinese astronomy, the stars of Cetus

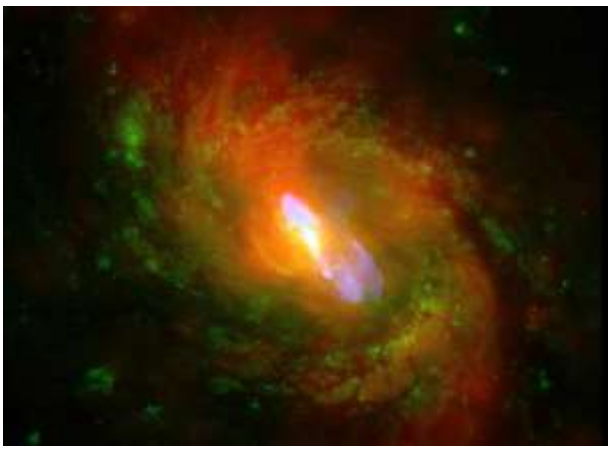
are found among the Black Tortoise of the North (*B?i F?ng Xuán W?*) and the White Tiger of the West (*X? F?ng Bái H?*).

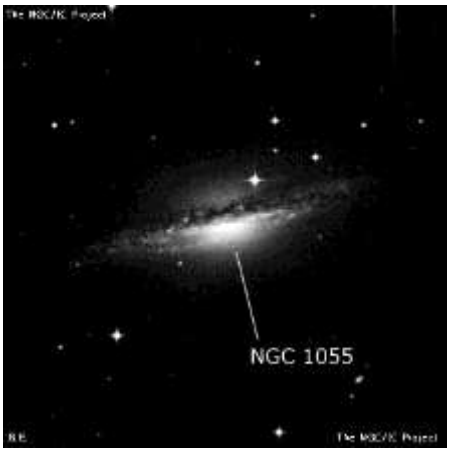
Cetus sprawls across 1231 square degrees of sky and contains 15 main stars, highlighted by 3 bright stars and 88 Bayer/Flamsteed designations. It's brightest star is Beta Ceti, otherwise known as Deneb Kaitos (Diphda), a type K0III orange giant which is located approximately 96.3 light years away. This star has left its main sequence and is on its way to becoming a red giant.

The name Deneb Kaitos is derived from the Arabic "*Al Dhanab al Kaitos al Janubiyy",* which translates as "the southern tail of Cetus". The name Diphda comes "*ad-dafda at-tani*", which is Arabic for "the second frog" – the star Fomalhaut in neighboring Piscis Austrinus is usually referred to as the first frog.)

Then there's Alpha Ceti, a very old red giant star located approximately 249 light years from Earth. It's traditional name (Menkar), is derived from the Arabic word for "nostril". Then comes Omicron Ceti, also known as Mira, binary star consisting located approximately 420 light years away. This binary system consists of an oscillating variable red giant (Mira A).

After being recorded for the first time by David Fabricius (on August 3, 1596), Mira has since gone on to become the prototype for the Mira class of variables (of which there are six or seven thousand known examples). These stars are red giants whose surfaces oscillate in such a way as to cause variations in brightness over periods ranging from 80 to more than 1,000 days.





Composite image of Messier 77 (NGC 1068), showing it in the visible, X-ray, and radio spectrums. Credit: NASA/CXC/MIT/ C.Canizares/ D.Evans et al/ STScI/NSF/ NRAO/VLA

Cetus is also home to many Deep Sky Objects. A notable examples is the barred spiral galaxy known as Messier 77, which is located approximately 47 million light years away and is 170,000 light years in diameter, making it one of the largest galaxies listed in Messier's catalogue. It has an Active Galactic Nucleus (AGN) which is obscured from view by intergalactic dust, but remains an active radio source.

Then there's NGC 1055, a spiral galaxy that lies just 0.5 north by northeast of Messier 77. It is located approximately 52 million light years away and is seen edge-on from Earth. Next to Messier 77, NGC 1055 is a largest member of a galaxy group – measuring 115,800 light years in diameter – that also includes NGC 1073 and several smaller irregular galaxies. It has a diameter of about 115,800 light years. The galaxy is a known radio source.

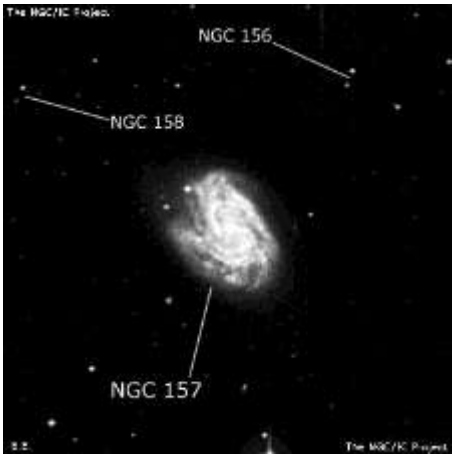
Finding Cetus:

Cetus is the fourth largest constellation in the sky, is visible at latitudes between +70° and -90° and is best seen at culmination during the month of November. Of all the stars in Cetus, the very first you must look for in binoculars is Mira. Omicron Ceti was the very first variable star discovered and was perhaps known as far back as ancient China, Babylon or Greece. The variability was first recorded by the astronomer David Fabricius while observing Mercury.

Now aim your binoculars at Alpha Ceti. It's name is Menkar and we do know something about it. Menkar is an old and dying star, long past the hydrogen and perhaps even past the helium stage of its stellar evolution. Right now it's a red giant star but as it begins to burn its carbon core it will likely become highly unstable before finally shedding its outer layers and forming a planetary nebula, leaving a relatively large white dwarf remnant.

Hop down to Beta Ceti – Diphda. Oddly enough, Diphda is actually the brightest star in Cetus, despite its beta designation. It is a giant star with a stellar corona that's brightening with age – exerting about 2000 times more x-ray power than our Sun! For some reason, it has gone into an advanced stage if stellar evolution called core helium burning – where it is converting helium directly to carbon.

Are you ready to get out your telescope now? Then aim at Diphda and drop south a couple of degrees for NGC 247. This is a very definite spiral galaxy with an intense "stellar" nucleus! Sitting right up in the eyepiece as a delightful oval, the NGC 247 is has a very proper galaxy structure with a defined core area and a concentration that slowly disperses toward its boundaries with one well-defined dark dust lane helping to enhance a spiral arm. Most entertaining! Continuing "down" we move on to the NGC 253. Talk about bright!



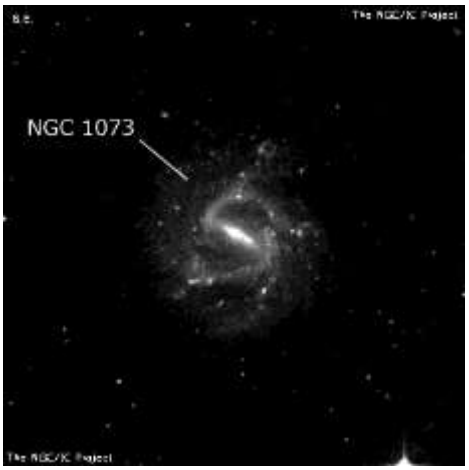
Very few galactic studies come in this magnitude (small telescopes will pick it up very well, but it requires large aperture to study structure.) Very elongated and hazy, it reminds me sharply of the "Andromeda Galaxy". The center is very concentrated and the spiral arms wrap their way around it beautifully! Dust lanes and bright hints of concentration are most evident. and its most endearing feature is that it seems to be set within a mini "Trapezium" of stars. A very worthy study…

Now, let's hop off to Delta Ceti, shall we? I want to rock your world – because spiral galaxy M77 rocked mine! Once again, easily achieved in the small telescope, Messier 77 comes "alive" with aperture. This one has an incredible nucleus and very pronounced spiral arms – three big, fat ones! Underscored by dark dust lanes, the arms swirl away from the center in a galactic display that takes your breath away!

The location of the Cetus Constellation. Credit: IAU/ Sky&Telescope magazine

The "mottling" inside the structure is not just a hint in this ovalish galaxy. I guarantee you won't find this one "ho hum"… how could you when you know you're looking at something that's 47.0 million light-years away! Messier 77 is an active galaxy with an Active Galactic Nucleus (AGN) and one of the brightest Seyfert galaxies known.

Now, return to Delta and the "fall line" runs west to east on the north side. First up is galaxy NGC 1073, a very pretty little spiral galaxy with a very "stretched" appearing nucleus that seems to be "ringed" by its arms! Continuing along the same trajectory, we find the NGC 1055. Oh, yes… Edge-on, lenticular galaxy! This soft streak of light is accompanied by a trio of stars. The galaxy itself is cut through by a dark dust lane, but what appears so unusual is the core is to one side!

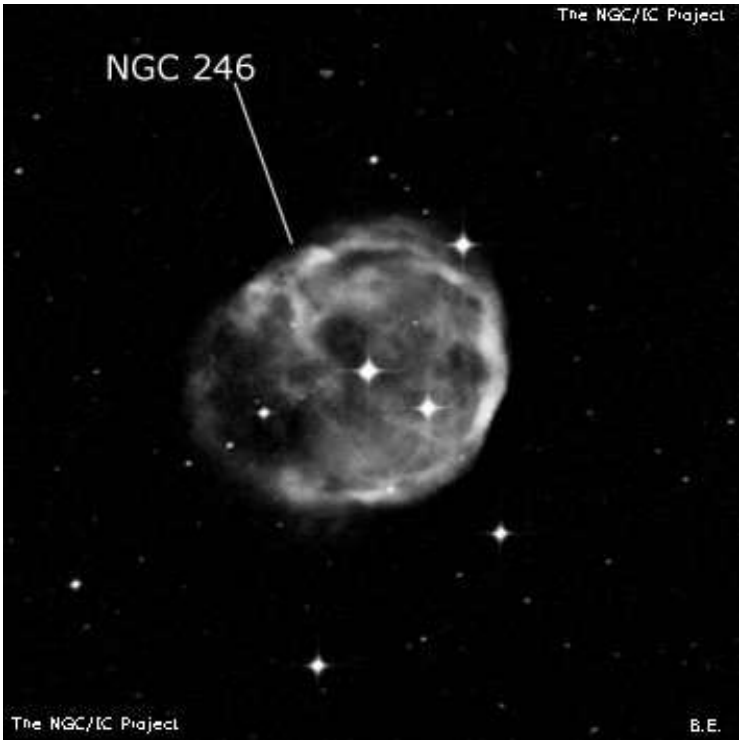


Now we've made it to back to the incredible M77, but let's keep on the path and pick up the NGC 1087 – a nice, even-looking spiral galaxy with a bright nucleus and one curved arm. Ready to head for the beautiful variable Mira again? Then let her be the guide star, because halfway between there and Delta is the NGC 936 – a soft spiral galaxy with a "saturn" shaped nucleus. Nice starhoppin'!

We have written many interesting articles about the constellation here at Universe Today. Here is What Are The Constellations?, What Is The Zodiac?, and Zodiac Signs And Their Dates.

Be sure to check out The Messier Catalog while you're at it!

For more information, check out the IAUs list of Constellations, and the Students for the Exploration and Development of Space page on Canes Venatici and Constellation Families.



Sources:

Constellation Guide – Cetus Constellation
Windows to the Universe – Cetus
Chandra Observatory – Cetus
Wikipedia – Cetus
Universe Today – Cetus Tammy Plotner

ISS PASSES For Dec/Jan 2020 /21 from Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
30 Nov	-3.8	17:12:42	10°	W	17:16:04	88°	NNW	17:18:35	17°	E
30 Nov	-2.0	18:49:32	10°	W	18:51:32	33°	W	18:51:32	33°	W
01 Dec	-3.8	18:01:59	10°	W	18:05:22	87°	S	18:05:55	60°	ESE
02 Dec	-3.8	17:14:25	10°	W	17:17:48	86°	N	17:20:20	17°	E
02 Dec	-1.9	18:51:15	10°	W	18:53:18	31°	WSW	18:53:18	31°	WSW
03 Dec	-3.4	18:03:39	10°	W	18:07:00	61°	SSW	18:07:47	44°	SE
04 Dec	-3.6	17:16:04	10°	W	17:19:26	76°	SSW	17:22:22	13°	ESE
04 Dec	-1.5	18:53:06	10°	W	18:55:20	24°	SW	18:55:20	24°	SW
05 Dec	-2.3	18:05:22	10°	W	18:08:28	35°	SSW	18:10:03	22°	SSE
06 Dec	-2.8	17:17:42	10°	W	17:20:57	47°	SSW	17:24:12	10°	SE
06 Dec	-0.8	18:55:38	10°	WSW	18:57:08	12°	SW	18:57:56	12°	SSW
07 Dec	-1.0	18:07:22	10°	W	18:09:45	18°	SW	18:12:07	10°	S
08 Dec	-1.5	17:19:27	10°	W	17:22:17	25°	SSW	17:25:07	10°	SSE
09 Dec	-1.9	16:31:40	10°	W	16:34:47	35°	SSW	16:37:53	10°	SE
10 Dec	-0.4	17:21:54	10°	WSW	17:23:25	13°	SW	17:24:56	10°	SSW
11 Dec	-0.6	16:33:35	10°	W	16:35:59	18°	SW	16:38:21	10°	S
19 Dec	-0.6	06:59:47	10°	S	07:01:48	15°	SE	07:03:49	10°	ESE
20 Dec	-0.1	06:14:11	10°	SE	06:14:18	10°	SE	06:14:24	10°	SE
21 Dec	-1.7	06:59:45	10°	SSW	07:02:44	29°	SSE	07:05:43	10°	E
22 Dec	-1.2	06:12:30	10°	SSW	06:15:07	21°	SE	06:17:45	10°	E
23 Dec	-0.9	05:26:08	12°	SSE	05:27:32	15°	SE	05:29:31	10°	ESE
23 Dec	-3.0	07:00:29	10°	SW	07:03:47	53°	SSE	07:07:05	10°	E
24 Dec	-2.5	06:13:56	18°	SW	06:16:03	40°	SSE	06:19:15	10°	E
25 Dec	-2.0	05:28:30	29°	SE	05:28:30	29°	SE	05:31:21	10°	E
25 Dec	-3.7	07:01:32	10°	WSW	07:04:55	81°	S	07:08:18	10°	E
26 Dec	-0.3	04:42:54	12°	E	04:42:54	12°	E	04:43:20	10°	E
26 Dec	-3.6	06:15:52	35°	SW	06:17:07	68°	SSE	06:20:29	10°	E
27 Dec	-2.5	05:30:09	40°	ESE	05:30:09	40°	ESE	05:32:38	10°	E
27 Dec	-3.8	07:03:06	13°	W	07:06:04	85°	N	07:09:27	10°	E
28 Dec	-0.4	04:44:21	13°	E	04:44:21	13°	E	04:44:45	10°	E
28 Dec	-3.8	06:17:18	45°	W	06:18:13	89°	N	06:21:37	10°	E
29 Dec	-2.5	05:31:25	41°	E	05:31:25	41°	E	05:33:45	10°	E
29 Dec	-3.8	07:04:22	14°	W	07:07:12	89°	S	07:10:35	10°	E
30 Dec	-0.4	04:45:30	13°	E	04:45:30	13°	E	04:45:54	10°	E
30 Dec	-3.9	06:18:26	46°	W	06:19:19	85°	N	06:22:43	10°	E
31 Dec	-2.5	05:32:29	42°	E	05:32:29	42°	E	05:34:50	10°	E
31 Dec	-3.5	07:05:25	14°	W	07:08:14	64°	SSW	07:11:34	10°	ESE
01 Jan	-0.4	04:46:30	13°	E	04:46:30	13°	E	04:46:57	10°	E
01 Jan	-3.8	06:19:27	44°	W	06:20:22	79°	SSW	06:23:44	10°	ESE
02 Jan	-2.6	05:33:28	44°	E	05:33:28	44°	E	05:35:52	10°	E
02 Jan	-2.8	07:06:24	13°	W	07:09:07	37°	SSW	07:12:15	10°	SE
03 Jan	-0.5	04:47:29	13°	E	04:47:29	13°	E	04:47:58	10°	E
03 Jan	-3.3	06:20:25	38°	WSW	06:21:18	50°	SSW	06:24:34	10°	SE
04 Jan	-2.5	05:34:27	40°	SE	05:34:27	40°	SE	05:36:47	10°	ESE
04 Jan	-1.9	07:07:23	11°	W	07:09:48	20°	SW	07:12:19	10°	SSE
05 Jan	-0.5	04:48:31	13°	ESE	04:48:31	13°	ESE	04:48:54	10°	ESE

END IMAGES, OBSERVING AND OUTREACH

My image of the year has been the Comet Neowise F3 2020 and a serendipitous huge display of Noctilucent clouds above the West Kennet Avenue stones. The last time the Neowise comet came around these stones had not been erected! Andy Burns.

December Observing Suggestion

Wiltshire Astronomical Society Observing Suggestions for November 2020 @ 21:00

We have updated the observation targets this month for those with binoculars or smaller wide field telescopes to have something to search for.

The WAS Observing Team will provide recommended observing sessions for you to do while maintaining social distancing away from the home or as part of your social bubble at the homes of close friends or relatives. Please always follow the latest government guidelines if observing away from the home.

These observing recommendations will continue until we can start our group observing again (hopefully) in the new year.

Most target objects can be found around due South and South-West at about 21:00.

Where To Look This Month:
This month we concentrate on the constellation of Taurus.

Just select 'What's Up' link below to get the PDF file.
What's Up Link:
WAS_November_2020.pdf
Also Wiltshire Astronomical Society will produce the monthly newsletter containing further information, which can be downloaded here: https://wasnet.org.uk/

OUTREACH

The November Zoom outreach worked very well. If you have any other schools or societies interested in astronomy and can project a zoom meeting I am now very comfortable for them to get in touch. Any topic.