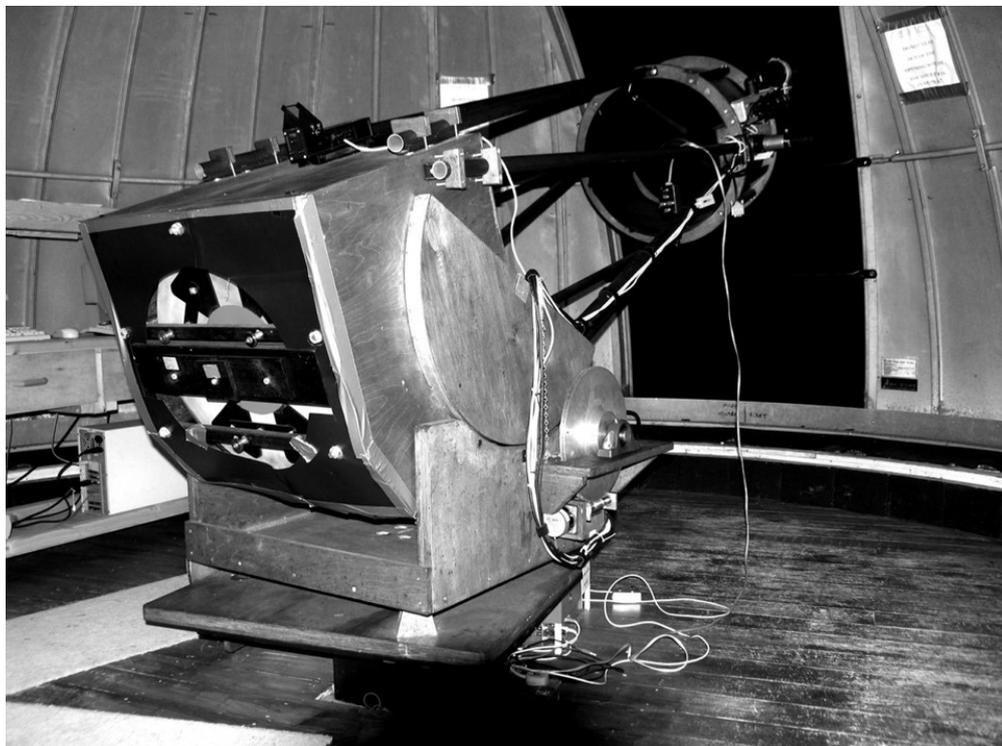


# Breckland Astronomical Society

Affiliated to the British Astronomical Association and the Federation of  
Astronomical Societies

## ***EXTRA*** ***TERRESTRIAL***

**Newsletter    December 2021**



Registered Charity no, 1044478

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Copy is always needed for this newsletter. Articles with an astronomical theme are welcome but anything of likely interest to the membership will be considered. Text or Word documents preferred but handwritten submissions also welcome.

Chris Bailey is the newsletter editor. [newsletter@brecklandastro.org.uk](mailto:newsletter@brecklandastro.org.uk)

Mick Ladner is visitor organiser. [visitors@brecklandastro.org.uk](mailto:visitors@brecklandastro.org.uk)

## Chairman's Notes December 2021

December is the month of Orion. I remember seeing Orion as a kid from the city after coming out of the pantomime on a rare late winter's night out. It is striking and perhaps as any naturalist may appreciate, (I'm thinking Richard Mabey) there is something comforting about seeing him return every year. You can see why many cultures see this complete constellation as depicting a man, he has a sword below his belt. One of the easiest things to point a new telescope at on a dark night is at the centre of the straight line of fainter stars below Orion's belt.

This is the giant gas cloud M42, the Great Orion Nebula. From the city through my 60mm cheap refractor, through a window pane, I barely saw anything other than a pair of stars. Had I had the chance to take that into a dark garden I may have been more impressed. I sketched M42 many a time through my second telescope, a 4 ½ inch equatorial refractor (smaller than the one won at the quiz night). I used to see it as blue/cyan, but many see it as greenish. In reality, only your night-vision 'rods' are sensitive to the dim light, but in a few big scopes such as our 20 inch, the edge of the central region shows a pink tinge as the light is concentrated enough to stimulate your red cones. The nebula itself is 1300 light years away, a little further than the bright stars of Orion, especially Betelgeuse which is about half that. Incidentally, I noticed Betelgeuse has brightened slightly when I last looked.

Through larger scopes, i.e. 8 inches and over you may see the trapezium of stars at the centre of the nebula well and on good nights, with high magnification, and patience, you can see what are called the E and F stars in this close group. There is a detailed description in one of last winter's magazines.

### Events

Foxwood forest school has been postponed due to cloud again. It was pretty cloudy the last month but it has briefly cleared again. There were a bunch of clear nights, but I was having an unusual tired spell and was predisposed this month, so not much to show. Even an aurora, which I missed due to young family commitments. One thing Astronomy (or Aeronomy in this case) makes you aware of is that the sky waits for no-one's earthly problems! When I did get out during a spell of auroral activity, the combination of light pollution and moist skies had conspired and blocked the show, even after a good journey from my home. Sadly, these new bluer spectrum LED lights and cheap "insecurity" lights give a wakeful daylight feel that spreads long distances and are stopping all but the north coast from seeing a display.

The October Open Night was full of enthusiasm and to the fascinated folk that joined us, welcome! It was not too crowded but just enough company for a great atmosphere. It's just about enjoying the heavens. We ran a policy of having two families/parties in at a time, and with doors ajar and hatch open this provides a good amount of ventilation in the observatory. There was plenty of 'space' and it was really clear for once! Chilly and a bit damp as expected. We had the two 8 inch Dobsonian telescopes out on the patio, one could fit the Pleiades nicely into the 32mm eyepiece. Taking the light into your eyes from stars in the Andromeda galaxy is always an awesome experience to behold, I will never tire of it. Darren's concrete laying job has served us well. The observatory itself is still holding up nicely fingers crossed.

Regarding visitors to observatory, we can't yet accommodate large parties, due to higher covid risks still. But it is nice to see there is a good deal of interest. As usual, we never have quite enough in the way of volunteers to usher and give tours of the observatory and the skies. Mick

Ladner has been quick and well organised in dealing with the visitor enquiries. We have had a few private visits, and it has been lovely to help show families such faraway sights they have never seen before. Evening helpers welcome, please come and join us Tuesdays at the observatory.

Quiz Night went well this year. It was great to be in the hall for a good social evening with 25 of us. Between us we raised a good bit, especially from the telescope raffle. It went to a keen chap from Attleborough who wants to bring it over and test. Andy was tearing up and counting raffle tickets for much of the night and still came within half a point of winning! Thanks to John C for donating his telescope. Thanks for John G and Mick for helping with the teas and coffees. We invested in a fine October speaker, so the funds raised November helped balance out the speaker and hall costs.

Next month we may reinstate Zoom for those still up for livestreaming, watch your email for details, subscribing members. There should be the final BAS100 draw. I may not be present in person at the talk!

## **Observatory**

A word of thanks. Richard and Keith, Tuesday regulars have been very handy recently. Attaching and providing a guide scope, fixing mounts (the telescope we gave away, our EQ mount), the radio hand pad, and Andy has ordered a new wired hand pad for the 20 inch. I have made myself handy with more mundane tasks such as keeping dirt, cobwebs, spiders and flies at bay and realising we need some new tissue roll for the observatory kitchen area. Looking after the small tasks is essential.

The society has such a fantastically powerful telescope, often sitting there underused. It would be great to meet the wider group (e.g. facebook group members) to introduce themselves in person, perhaps a keen new face would like to learn the ropes of operating the big scope and discover its potential, like I did many years ago. It can be very rewarding.

## **Bank Account**

Andy our dedicated treasurer and membership secretary has been informed our bank account (HSBC) is now charging us for transactions and a monthly fee. Therefore we will have to move it, so the committee has decided to go with a Co-Op account. We may keep the HSBC one until January direct debit subscriptions are in but we will run the two simultaneously for a while until all have had time to move. You will be informed the new details via Mailchimp, once the application has been finalised.

PS Thanks Martin for providing a great article in this edition and responding to our request for content. More welcome!

*Dan Self*

# JOHN'S NEWS BITS

## December 2021

Reported on space.com, astronomers at the ALMA observatory in Atacama have detected water in a distant galaxy some 12.88 billion light years distant proving the existence of water in the earliest stars.

Space.com, the first exoplanet ever detected in a galaxy outside the Milky Way. Astronomers used the Chandra X-ray observatory and ESA's XMM-Newton space telescope investigated Messier galaxies M51, M101 and M104 and located the exoplanet in M51 (Whirlpool galaxy), some 28 million light years away, using the transit method

NASA's DART mission was successfully launched on a SpaceX falcon 9 rocket on November 23<sup>rd</sup>. the mission is to impact a 160 metre wide asteroid Dimorphos, in an attempt to alter its trajectory as a practice run in case of an asteroid heading for Earth.

Dimorphos is 6.2 million miles from Earth and orbits a 780 metre asteroid called Didymos. An LICIACube will be released prior to impact to monitor the actual collision. Earth base telescope will measure how much the asteroid has been moved.

JWST, the James Webb Space telescope still on track for launch on December 18 on an Ariane 5 rocket. The gigantic 6.5 metre mirror folded up like a piece of origami to fit in the rocket's cone....latest: more delay until December 24 due to vibrations from the JWST during pre-launch preparations.

NASA's Artemis SpaceX mission to send the Orion spacecraft on a round trip to the Moon is scheduled for February 12, 2022. This is an uncrewed test mission to the Moon and back.

A 330 metre long Asteroid 4660 Nereus will be within 3.9 million miles from Earth on December 11<sup>th</sup>. NASA reckons there is no need to panic, that's comforting!

Detected a merger of a black hole and a neutron star  
A black hole 33 times size of Sun has merged with a low mass neutron star, 1.17 times mass of the Sun.. The event was detected by LIGO in USA and Italy.

NASA DAVINCI+ probe to Venus together with VERITAS probe manufactured by Applied Physics Lab. Is part of the NASA Discovery programme.

This will have an orbiter and a decent probe some time in 2029/30 with entry in 2031/32

Reported in space.com, the Moon has enough oxygen trapped in the regolith to sustain 8 billion people for 100,000 years.

The regolith will require special equipment to extract it with 1.4 million tons generating 630kg of oxygen.

Nov. 13, Russia carried out a missile test destroying one of its satellites. This created international outrage as the debris could threaten the ISS and other satellites in low Earth orbit.

In 1970, China did something similar and created some 3,000 pieces the size of golf balls and at least 100,000 smaller bits of debris.

The Artemis Moon mission due to land astronauts in 2024 has been delayed apparently due to an ongoing legal suit between Bezos and Musk for the contract to build the lunar landing vehicle. Bezos was initially chosen but the contract finally went to SpaceX. Now pushed back to 2025

John Gionis

## What's up in December 2021?

Venus starts the month at 24% phase and quite bright. It rises its highest at sunset at the start of the month, never having achieved much altitude this year. On the 7<sup>th</sup> a 16% moon lies to the left of Venus, which should be above the horizon and visible from 16:25 until 18:00. On the evening of the 8<sup>th</sup>, the moon had moved to between Saturn and Jupiter, as Jupiter and Venus near conjunction with the Sun. By the 9<sup>th</sup> we will have to wait until 21:30 for the sky to darken after a 37% crescent moon. By the time we are at the 11<sup>th</sup> December (Saturday), the Lunar X is visible but in daylight from 2pm until sunset at 16:30, whereupon its distinct definition will start to get lost.

The next dark skies will come when the moon has passed full and is a waning gibbous rising at 8pm on the 23<sup>rd</sup> or 21:10 on Xmas Eve in NE Leo. It rises early due to its northerly declination. After Xmas we wish you many dark nights to try out telescopes, and welcome you to our open night on Thursday 30<sup>th</sup> December (not the Friday as this is New Years Eve) from 18:30. On this night, we may glimpse comet **19P/ Borelly** in Cetus.

Maybe start any telescope observing sessions by aiming at a star, eg Betelgeuse, checking the finder scope, focus, etc. and then go for M42 and zoom in. This is always a treat.

A telescopic target is **67P/ Churyumov-Gerasimenko** (Чурюмов-Герасименко), Rosetta and Philae's comet in Cancer, not moving fast, rather at a stationary point just East of iota Cancri. Check out NGC 2683, a galaxy just North of that star and above the comet. One of my favourite galaxies, a edge-on spiral that looks a bit like a flying saucer so is nicknamed the UFO galaxy. Life might exist there (though of course that sentence is scientifically completely pointless). It is 30 million light years away.

A fainter outer solar-system comet **29P/Schwassmann-Wachmann 1** has just undergone several outbursts and may be a little brighter. This is in Northern Taurus.

The Geminid meteor shower is on the 12<sup>th</sup> - 13<sup>th</sup> and are slightly washed out by the moon, visually and rates will be better after the moon sets at 1:30 and 2:40 am.

An interesting selection of telescopic objects I would suggest would be the following. Starting early in the evening.

M31 – start with a high, bright, large galaxy, you can even venture to its satellite galaxies. It fills you with wonder that there are more stars there than in our entire Milky Way and it is 2.5 million light years away.

Much much much closer, but still a hell of a long way away is tiny Uranus 3.7". This is where you need to increase your magnification. Also, Neptune at 2.2" is even smaller and a good challenge for your telescope's resolving power. A disk is visible in the 20 inch telescope, but so it should! The seeing has to be playing ball.

Later at around 8pm, the constellations: Cetus, Eridanus, then Lepus and Canis Major roll around the South. I would look for M77, the Seyfert galaxy with a bright centre. Then NGC 1315 a small green planetary nebula in Eridanus, R Leporis, which can be tricky to find and need good charts – this is a very red carbon star, Then even more challenging is tiny, pinkish planetary nebula IC 418 in Lepus below Orion.

Higher in the sky, earlier on we have NGC 891, a beautiful edge on galaxy near Andromeda. Later on we could visit the Crab Nebula supernova remnant from 1054AD, aka M1, near zeta Tauri – a fairly easy find but may take a while hunting around. Then there is the Eskimo nebula, NGC 2392, which looks like a nice pair of blobs until you zoom in and see one is a fainter star with a diffuse small circular shell of nebulous glow around it. This one really teaches you about using Averted vision, i.e. looking away slightly. You can practice using averted vision to see fainter objects with the more sensitive outer part of your retina.

Dan Self

# **THE HISTORY OF BLACK HOLES**

**by Martin Kaye**

## **In the beginning ....**

The history of black holes can be traced back to 1784, when English astronomical pioneer and clergyman John Michell proposed the idea of a body so massive that light could not escape. He called these 'dark stars'. Michell accepted Newton's corpuscular theory of light and he reasoned that such particles, when emanated from a star, would be slowed down by its gravitational pull. He went on to reason that the star's gravitational pull might be so strong that the escape velocity would exceed the speed of light. Since light would not be able to escape, the star would be invisible.

It is thought that first use of the term 'black hole' was at a meeting in 1964 of the American Association for Advancement of Science. John Wheeler then used the term at a lecture and subsequently adopted and popularised the name.

## **Just what is a 'black hole'?**

Massive stars die when they can no longer support their own weight with radiation pressure from fusion, so they collapse. The implosion triggers a shock wave that tears the star apart in a violent supernova explosion. If the original star was more than 20 solar masses, the core left behind collapses to infinite density and becomes a singularity, and you have a stellar-mass black hole.

Black holes have captured the public imagination for years as some of the universe's most exotic objects. To put their density in context, if Earth was compressed into a black hole it would be the size of a marble. So what is a black hole? It is a region of spacetime where gravity is so strong that nothing, no particles or even electromagnetic radiation such as light, can escape from it. It is now thought that most, if not all, galaxies have one at their centre.

## **Back to the history**

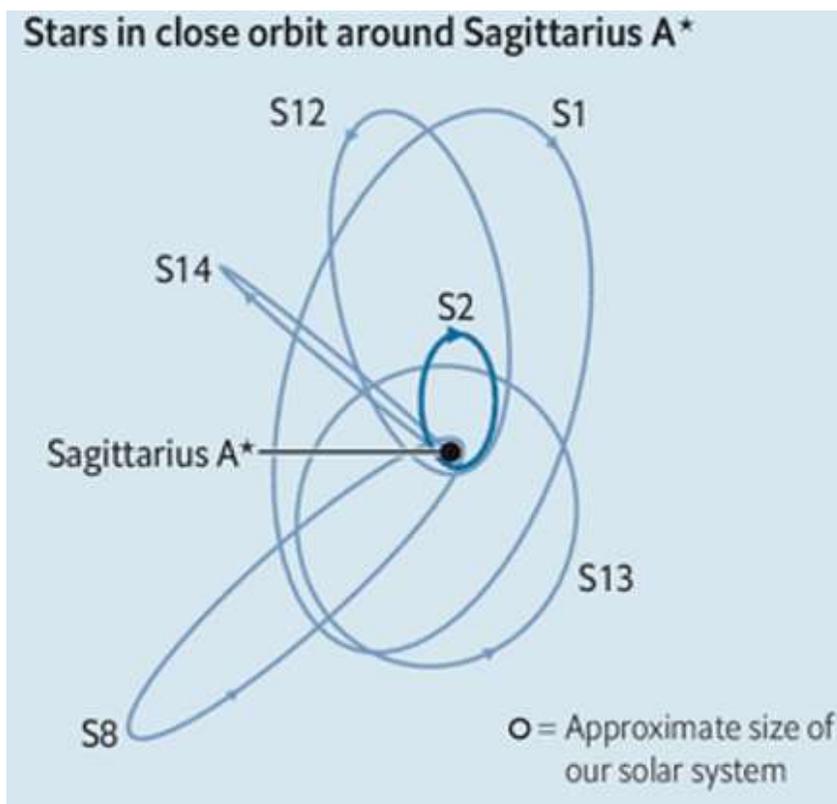
When Mitchell died in 1793 his ideas were buried with him for a century. But in 1915, Albert Einstein expanded his special theory of relativity to include gravitational forces along with electricity and magnetism. He wrote to Karl Schwarzschild, then serving on the eastern front in the First World War, who, despite living in the trenches at the time, wrote back within days describing the solution to Einstein's field equations. Tragically Schwarzschild died a year later but left behind a solution that completely describes how space-time is warped outside a dense spherical object. The solution showed how, for high-density stars, it becomes harder to escape the gravitational field of the star. There comes a point where everything, even light, is trapped; this is known as the event horizon.

For 50 years these as yet unnamed 'black holes' were not considered as anything other than a mathematical curiosity, despite Subrahmanyan Chandrasekhar's discovery in 1930 that massive stars can collapse under their own gravity to reach enormous or even infinite densities; Oppenheimer and Snyder's work on the unstable contraction of a massive neutron star, what we would now call a black hole; and Maarten Schmidt's discovery of the first quasar in 1963.

## Recent discoveries

It was the advent of X-ray astronomy in the 1960s provided the tools to progress the science. X-ray emissions are blocked by the Earth's atmosphere, so it was not until scientific instruments could be lifted above the atmosphere that X-ray sources could be discovered. In 1964 X-rays were picked up by Geiger counters on a rocket that were traced to a system containing a blue supergiant star orbiting another massive object. This is Cygnus X-1, now widely accepted as the first black hole discovered. Initial estimates put it closer and smaller but it is now thought to be 7,200 light-years from Earth, 21 times the mass of our Sun with an event horizon of 300km.

In February 1974, Bruce Balick and Robert Brown discovered radio waves emanating from the centre of the Milky Way. This object later became known as Sagittarius A\* and is 4 million times our Sun's mass. Further proof comes from mapping the movement of stars around centre of Milky Way (see below)

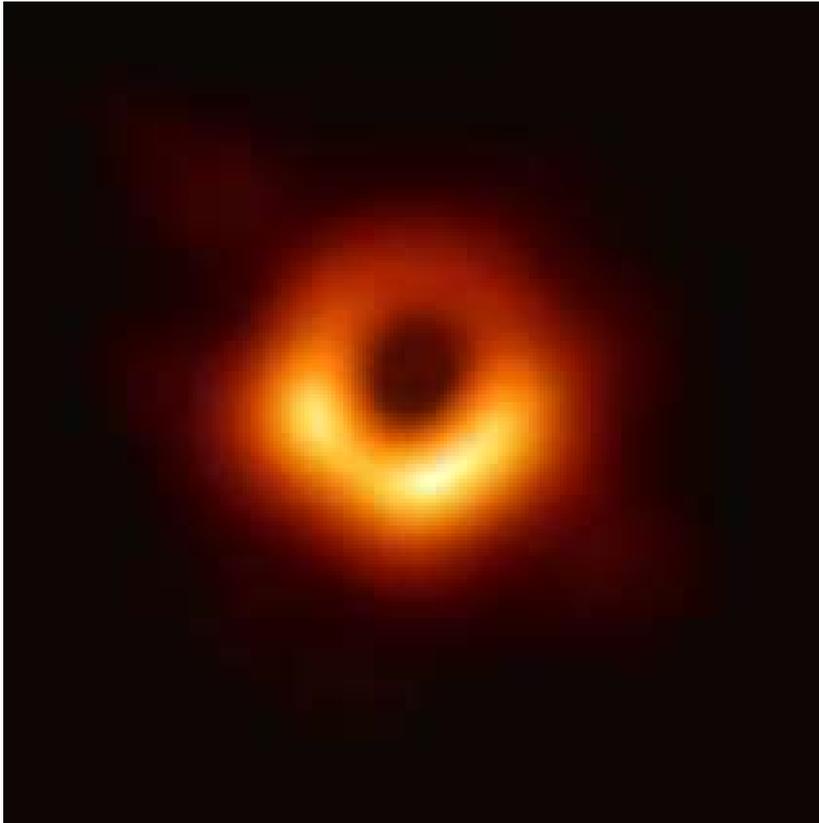


*By watching the motions of stars orbiting the Milky Way's central region, astronomers demonstrated there must be a supermassive black hole at the centre.*

Black holes can merge and create gravitational waves, disruptions in space-time. This is one of general relativity's most famous predictions. The Laser Interferometer Gravitational-wave Observatory (LIGO) was set up to test this theory and in September 2015 made the first direct observation of gravitational waves produced by the merger of two black holes.

The first direct visual evidence of a black hole is the now famous image of a supermassive black hole taken in April 2019 of Messier 87, a galaxy 55m light-years from Earth and 15 times the

mass of our Sun, see below. Captured by the Event Horizon Telescope, an international collaboration of 8 radio telescopes around the globe, operating as if they were one telescope the size of our planet. The EHT picks up radiation emitted by particles within the disc that are heated to billions of degrees as they swirl around the black hole at close to the speed of light, before vanishing across the event horizon, the point of no return, beyond which no light or matter can travel fast enough to escape the inexorable gravitational pull of the black hole.



*The halo's crescent-like appearance is because the particles in the side of the disc rotating towards Earth are flung towards us faster and so appear brighter. The dark shadow within marks the edge of the event horizon.*

### **The future**

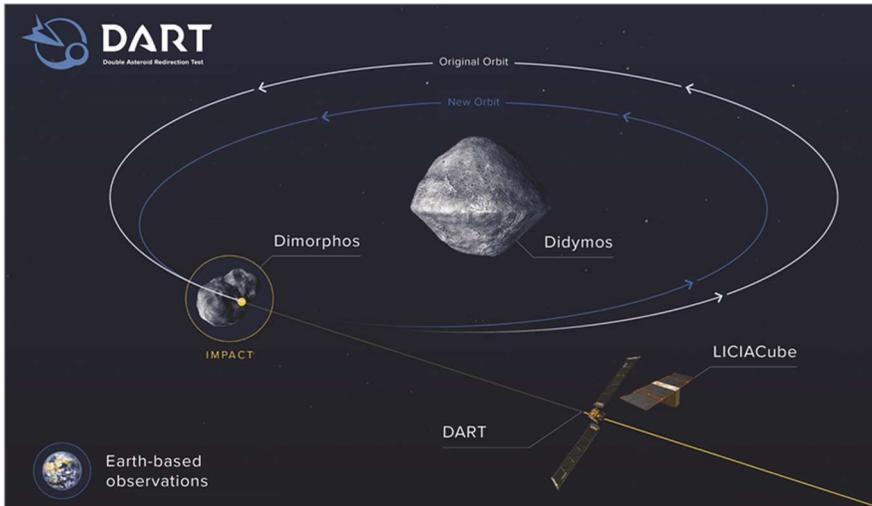
What of the future? If this article was written mid-century, would we be able to answer questions such as how are supermassive black holes formed; did galaxies form around pre-existing black holes or the holes formed after those galaxies had come into being? And how much more will we know about the supermassive black hole at the centre of our own Milky Way, Sgr A\*?

# NASA DART Mission



NASA's Double Asteroid Redirection Test, or DART, is the world's first full-scale planetary defence test, demonstrating one method of asteroid deflection technology. As part of NASA's larger planetary defence strategy, the DART mission will prove that a spacecraft can autonomously navigate to a target asteroid and intentionally collide with it, a method of asteroid deflection known as kinetic impact. DART will simultaneously test new technologies and provide important data to enhance our modelling and predictive capabilities and help us better prepare for an asteroid that might pose a threat to Earth, should one be discovered.

True to its name, DART is a focused spacecraft, designed to direct itself to impact an asteroid at roughly 15,000 miles per hour, or 4 miles per second (6 kilometres per second). Its target, which poses no threat to Earth, is the asteroid moonlet Dimorphos (Greek for "two forms"), which orbits a larger asteroid named Didymos (Greek for "twin").



Very few of the billions of asteroids and comets orbiting our Sun are potentially hazardous to Earth, and no known asteroid poses a threat to our planet for at least the next century. The DART mission is a key test that NASA will perform before any actual need, better preparing our defences should we ever discover an asteroid on a collision course with Earth.

The DART spacecraft, which was built and is operated by the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland, at the direction of NASA's Planetary Defence Coordination Office (PDCO), is designed to demonstrate that an asteroid that could cause regional devastation — one just a few hundred feet across — can be deflected by intentionally crashing a spacecraft into it. This method, called kinetic impact deflection, is just one of several proposed ways to redirect potentially hazardous asteroids, but it's the one currently assessed as the most technologically mature.



A SpaceX Falcon 9 rocket lifts off from Space Launch Complex 4 at Vandenberg Space Force Base in California on Nov. 23, 2021, carrying NASA's Double Asteroid Redirection Mission spacecraft. Lift off was at 10:21 p.m. PST. Photo credit: NASA

DART is a test of our ability to achieve a kinetic impact on an asteroid and observe the asteroid's response to that kinetic impact. DART's engineers have developed and are implementing the technology to make an impact happen; after impact, the investigation team will measure how much the asteroid is deflected using telescopes on Earth. This mission also engages the international planetary science community in many ways, embracing worldwide cooperation to address the global issue of planetary defence.

DART's kinetic impact can improve models and better prepare us to mitigate hazardous asteroids.

Although planetary scientists can create miniature impacts in a lab and build sophisticated computational models based on those results, asteroids are complicated bodies with a range of physical properties, internal structures, shapes and geologic features. Carrying out a real-world test on an asteroid of relevant size is a necessary next step to evaluate the models developed to date and advance them further to address potentially hazardous asteroids in the future.

As the first planetary defence test mission to demonstrate one method of asteroid deflection, DART's impact into an asteroid with mostly unknown physical properties will both enhance and validate scientific computational models that are crucial to predicting the effectiveness of a kinetic impactor. Scientists will use the telescopic observations of the Didymos system, images of Dimorphos taken by the onboard Didymos Reconnaissance and Asteroid Camera for Optical navigation (DRACO) and images of the DART impact event collected by the Italian Space Agency's Light Italian CubeSat for Imaging of Asteroids (LICIACube)



LICIACube, Italy's first deep-space mission. LICIACube, also called the Light Italian CubeSat, will follow the DART spacecraft all the way to its destination, the Didymos asteroid system, as it has been assigned the job to act as eyes and ears of scientists here on Earth. The spacecraft will create a real photoshoot of the impact when NASA's probe collides with the asteroid and beam the data back to the scientists. Where the DART spacecraft is the size of a bus, LICIACube is

relatively smaller as it weighs only 14 kilograms and is equipped with two optical cameras- LUKE (LICIACube Unit Key Explorer) and LEIA (LICIACube Explorer Imaging for Asteroid)

The need for LICIACube emerged as DART also has a powerful camera, called DRACO, but it will be destroyed after the spacecraft crashes into the asteroid, leaving scientists only with LUKE and LEIA. Built to last six months, the Italian probe will separate from the DART spacecraft ten days before the impact and take pictures of the remnants of the collision.

Bits of interplanetary dust and rock hit Earth all the time. Most of these are harmless and burn up in our planet's atmosphere. Occasionally, some bigger objects make it through, causing local damage or, in extreme cases, massive devastation. But with the right technology and knowledge of asteroids' orbits, scientists can anticipate and prevent an impact by deflecting an asteroid just enough to avoid a collision.

NASA's Double Asteroid Redirection Test, or DART, is the first mission to demonstrate the technology to deflect an asteroid. DART will use an autonomous guidance system to aim itself at the asteroid moonlet, Dimorphos, which it will strike at just over 4 miles per second (6 kilometres per second), causing a small change in the asteroid's motion. Telescopes on Earth will then measure the amount the asteroid is deflected by observing the change in the moonlet's orbit around its larger asteroid, Didymos.

DART's impact at Dimorphos is scheduled to occur between September 26 and October 1, 2022.

## Why Planetary Defence?

On Feb. 15, 2013, an undetected asteroid entered Earth's atmosphere and exploded over Chelyabinsk, Russia, causing an airburst and shockwave that struck six cities around the region. The blast injured more than 1,600 people and caused an estimated \$30 million in damage. It was a stark reminder that potentially hazardous objects can enter Earth's atmosphere at any time, and that even relatively small ones can be of concern. The Chelyabinsk object was just about 60 feet (18 meters) in size. Astronomers estimate that there are approximately 25,000 near-Earth asteroids close to 500 feet (140 metres) or larger in size — big enough to cause regional devastation if they were to hit Earth. This underscores the need to both discover and track near-Earth objects, as well as perform real-world tests of potential asteroid deflection.

Asteroids, like Earth and the other planets, orbit the Sun, but they become hazardous only if their orbits and Earth's orbit intersect at the same point and time. The key to preventing an impact is the ability to predict such mutual arrivals well in advance, then alter the asteroid's path, even slightly, to make the asteroid arrive early or late, missing a collision with Earth.

DART will demonstrate an asteroid deflection technique called kinetic impact, in which a spacecraft deliberately collides with an asteroid at high speed to slightly change the object's motion. The DART spacecraft will collide with the asteroid moonlet, Dimorphos, attempting to change the orbit around its larger companion, Didymos. Although simple in principle, the execution of such a technique demands a lot of engineering expertise and advanced planning, including extensive modelling and simulation of the kinetic impact ahead of launch, as well as precise Earth-based telescope observations of the asteroid system before and after impact.

## Why the Didymos System?

DART's target is the binary asteroid system Didymos, which is made up of a larger asteroid named Didymos (2,500 feet, or 780 meters, in diameter) and a smaller, orbiting asteroid moonlet named Dimorphos (525 feet, or 160 meters, in size).

This asteroid system is the ideal natural laboratory for DART's tests. The Didymos system is an eclipsing binary, meaning that from our vantage on Earth, Dimorphos regularly passes in front of and behind Didymos as it orbits. Consequently, Earth-based telescopes can measure the regular variation in brightness of the combined Didymos-Dimorphos system to determine how long it takes Dimorphos to orbit Didymos.

Because it's not on a path to collide with Earth, the Didymos system poses no actual impact threat to our planet, yet its relatively close proximity provides an easy way for planetary defence experts to observe and measure the effect of DART's kinetic impact. Mission planners selected autumn 2022 for DART's impact to minimize the distance between Earth and the Didymos system. Although Didymos will still be roughly 6.8 million miles (11 million kilometres) from Earth at that time, telescopes around the world will be able to contribute to an international observation campaign to determine the spacecraft's effect. The close proximity will allow for higher quality telescopic observations and streaming video of DART's final hours back to Earth just prior to impact.

The DART demonstration has been carefully designed. DART will hit Dimorphos nearly head-on, delivering enough energy to leave an impact crater but not enough to destroy the asteroid, eject it from its orbit around Didymos, or noticeably change the pair's orbit about the Sun. Scientists estimate the collision will shorten Dimorphos' orbital period by several minutes. Telescopic observations in the weeks after impact will confirm that DART changed Dimorphos' orbital period and reveal by exactly how much. Choosing a binary asteroid target for this demonstration takes advantage of the fact that changes in the smaller asteroid's orbit around its larger partner can be more easily measured than changes in a single asteroid's orbit around the Sun.



### **DRACO**

The DART payload consists of a single instrument called DRACO, a high-resolution imager. Inspired by the Long-Range Reconnaissance Imager on the New Horizons spacecraft, which delivered the first close-up images of the Pluto system and a Kuiper Belt object, the upgraded DRACO will not only snap images of Didymos and Dimorphos on approach to measure the size and shape of the asteroid target, providing essential data for the analysis and interpretation of the kinetic impact test results, but it will also support the autonomous guidance system for the DART spacecraft.

DRACO is a narrow-angle telescope with a 208-millimeter aperture and field of view of 0.29 degrees. It has a complementary metal-oxide semiconductor (CMOS) detector and sophisticated onboard image processor to determine the relative location of Dimorphos and support SMART Nav. The

images acquired by DRACO before the kinetic impact will be streamed back to Earth in real time. In its final moments, DRACO will help characterise the impact site by providing high-resolution scientific images of the surface of Dimorphos.

DART's single instrument, the Didymos Reconnaissance and Asteroid Camera for Optical navigation (DRACO), will turn on a week after launch and provide first images from the spacecraft. DART will continue to travel just outside of Earth's orbit around the Sun for the next 10 months until Didymos and Dimorphos will be a relatively close, 6.8 million miles (11 million kilometres) from Earth.

A sophisticated guidance, navigation, and control system, working together with algorithms called Small-body Manoeuvring Autonomous Real Time Navigation (SMART Nav), will enable the DART spacecraft to identify and distinguish between the two asteroids. The system will then direct the spacecraft toward Dimorphos. This process will all occur within roughly an hour of impact.

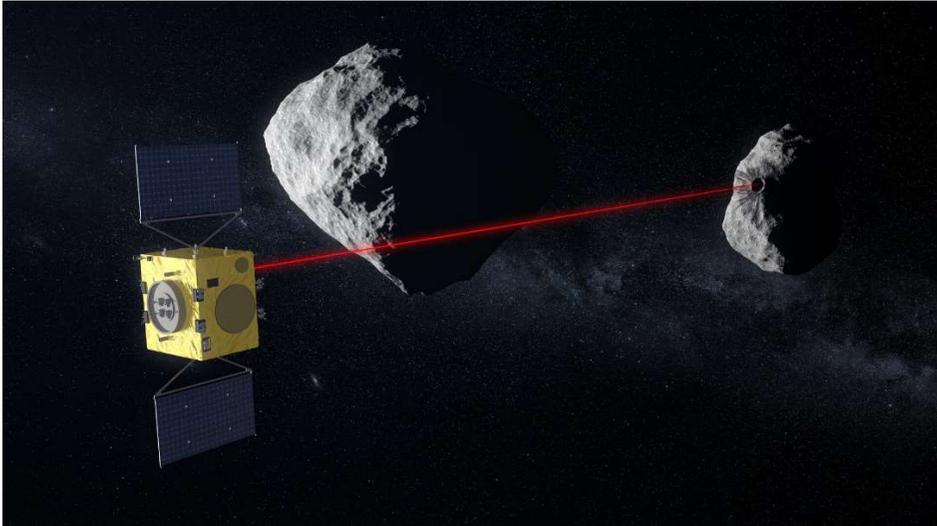
## Telescopic Observations

Using powerful telescopes located around the world, astronomers have acquired a long-term baseline of data on the Didymos asteroid system. While little is known about the asteroid that DART will impact — the exact shape and structure of Dimorphos, for example, remains a mystery — telescope observations have helped to further characterize the behaviour of the Didymos asteroid system. These observations are absolutely critical. Because the core of the second part of DART's test is to measure the effect of the kinetic impact on the asteroid, learning all we can about the Didymos Dimorphos system before impact, to compare with what we see after, is essential.

Even with the most powerful telescopes, Didymos and Dimorphos still appear as little more than a single point of light from Earth. During observations, scientists measure the brightness of that point of light over and over again, building up a plot of the light curve and looking for changes in brightness. Brightness changes indicate when the asteroid moonlet, Dimorphos, passes in front of or is hidden behind Didymos from Earth's viewpoint. Precise knowledge of Dimorphos' orbital period is essential for the DART mission. Repeated observations of the system enable more accurate predictions of where Dimorphos is at any given moment — including the moment of DART's impact. These observations, made years before launch, will help scientists determine the location of both asteroids and inform the exact timing of DART's impact to maximize the deflection. Similar observations after impact will reveal the change made to the system and enable the team to calculate the precise effects of the kinetic impact.

The DART mission relies on telescopes at observatories around the globe, including the Lowell Discovery Telescope in Arizona, Las Campanas Observatory in Chile, the Las Cumbres Observatory global network, and the Magdalena Ridge Observatory in New Mexico, as well as dozens of other partners and observatories.

## HERA AND THE AIDA INTERNATIONAL COLLABORATION



Using its laser altimeter Hera scans Didymos's surface. ESA's Hera mission

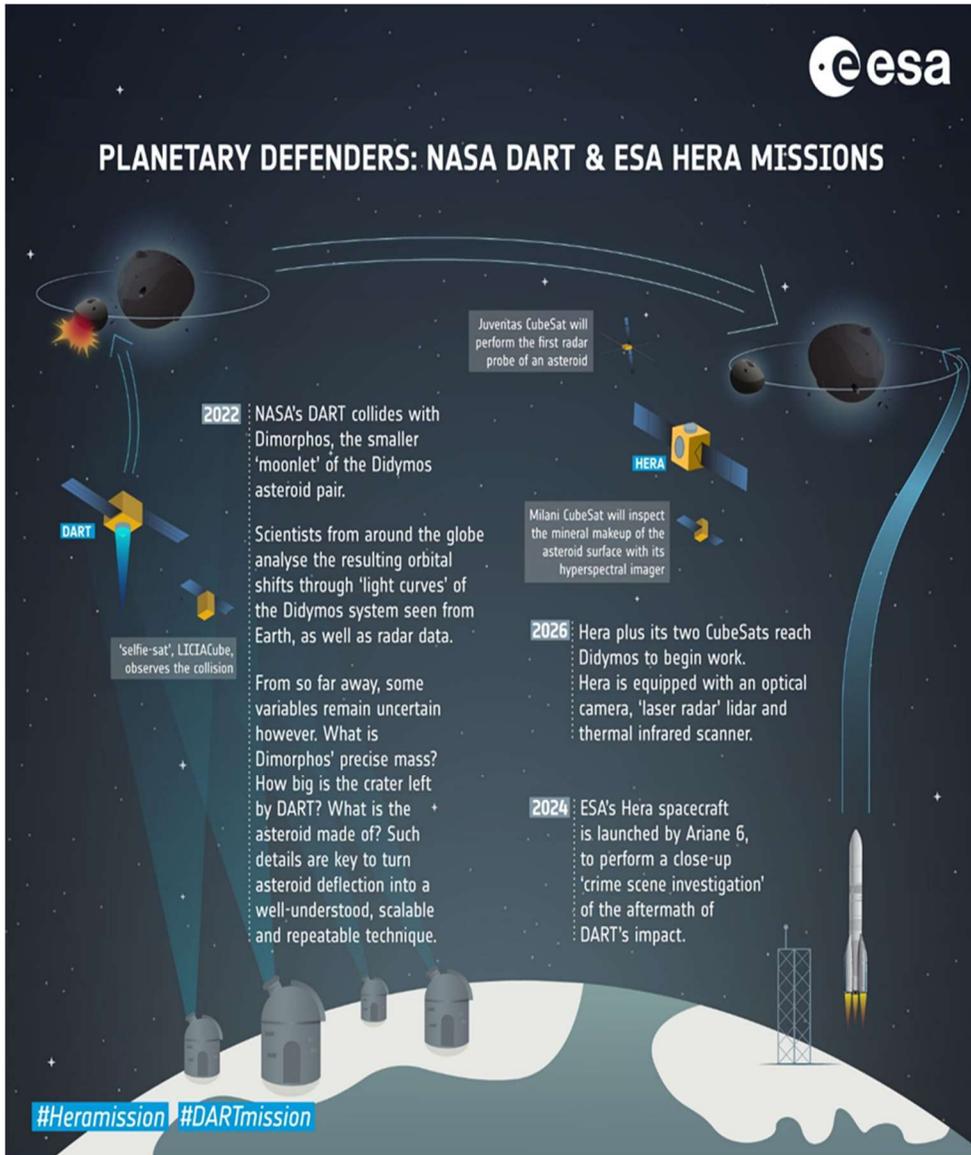
(Image courtesy of ESA)

The Hera mission, a European Space Agency (ESA) project, is planned to launch in 2024 and rendezvous with the Didymos system in 2026, roughly four years after DART's impact. Hera's main spacecraft and two companion CubeSats will conduct detailed surveys of both asteroids, with particular focus on the crater left by DART's collision and a precise determination of Dimorphos' mass. Hera's detailed post-impact investigations will substantially enhance the planetary defence knowledge gained from DART's asteroid deflection test.

DART and Hera are designed and operated independently, but together they will significantly boost the overall knowledge return of the collaboration. NASA's DART mission is fully committed to international cooperation, and ESA's Hera team members are welcome collaborators on the DART team.

Both DART and Hera team members are part of the international endeavour known as the Asteroid Impact and Deflection Assessment (AIDA) collaboration. AIDA will combine the data obtained from DART, including the Italian Space Agency's LICIACube, and Hera to produce the most accurate knowledge possible from the first demonstration of asteroid deflection technology. AIDA comprises the combined effort of the DART, LICIACube and Hera teams, along with others performing related research worldwide, to extract the best possible information for planetary defence and solar system science from these ground-breaking space missions. The AIDA collaboration exemplifies the understanding that planetary defence is an international effort and

that scientists and engineers around the world seek to solve problems related to planetary defence through international collaboration.



Courtesy of ESA

Credits NASA & ESA

# 2022 solar system events visible from the UK

So you can plan your dark sky observing sessions, here are **Moon** phase times. However, the first quarter moon sets late around the spring equinox (as the Moon is at a northerly declination), and likewise the third quarter rises late also (as the Moon is at a southerly declination). The reverse is true around the autumn equinox – the first quarter moon is low and sets early, and vice versa.

from [timeanddate.com/moon/phases](http://timeanddate.com/moon/phases)

Lunation	New Moon	First Quarter	Full Moon	Third Quarter	Duration
1225	2 Jan 18:33	9 Jan 18:11	17 Jan 23:48	25 Jan 13:40	29d 11h 12m
1226	1 Feb 05:46	8 Feb 13:50	16 Feb 16:56	23 Feb 22:32	29d 11h 49m
1227	2 Mar 17:34	10 Mar 10:45	18 Mar 07:17	25 Mar 05:37	29d 12h 50m
1228	1 Apr 07:24	9 Apr 07:47	16 Apr 19:55	23 Apr 12:56	29d 14h 04m
1229	30 Apr 21:28	9 May 01:21	16 May 05:14	22 May 19:43	29d 15h 02m
1230	30 May 12:30	7 Jun 15:48	14 Jun 12:51	21 Jun 04:10	29d 15h 22m
1231	29 Jun 03:52	7 Jul 03:14	13 Jul 19:37	20 Jul 15:18	29d 15h 03m
1232	28 Jul 18:54	5 Aug 12:06	12 Aug 02:35	19 Aug 05:36	29d 14h 22m
1233	27 Aug 09:17	3 Sep 19:07	10 Sep 10:59	17 Sep 22:52	29d 13h 37m

Lunation	New Moon	First Quarter	Full Moon	Third Quarter	Duration
1234	25 22:54 Sep	3 Oct 01:14	9 Oct 21:54	17 Oct 18:15	29d 12h 54m
1235	25 Oct 11:48	1 Nov 06:37	8 Nov 11:02	16 Nov 13:27	29d 12h 09m
1236	23 22:57 Nov	30 14:36 Nov	8 Dec 04:08	16 Dec 08:56	29d 11h 20m
1237	23 10:16 Dec	30 01:20 Dec	6 Jan 23:07	15 Jan 02:10	29d 10h 36m

The **ISS** makes an appearance in January evenings, from the 7<sup>th</sup> to the 12<sup>th</sup> at ~7pm then in the mornings from 13<sup>th</sup> to 18<sup>th</sup> at ~5am, then almost exactly the same dates again in February, provided there are no major orbital changes, due to e.g. debris avoidance! Can't predict much later due to orbital uncertainties building up.

### Comets

The year starts with the perihelion of the long-period comet **C/2021 A1 Leonard**, on the 3<sup>rd</sup> January. It is brightening more than predicted but invisible to us here in 2022 as it is in Piscis Austrinus. During December 2021 it will skirt the west horizon moving left night-on-night, passing above Arcturus on 5-6<sup>th</sup> Dec 2021, visible at 16:30. Or it will be much higher if you can get up in the morning - 5:30am should be good viewing, until the 10<sup>th</sup> December when it is in Southern Hercules.

It is also incidentally the perihelion of Earth on January 4<sup>th</sup>, not that anyone would notice!

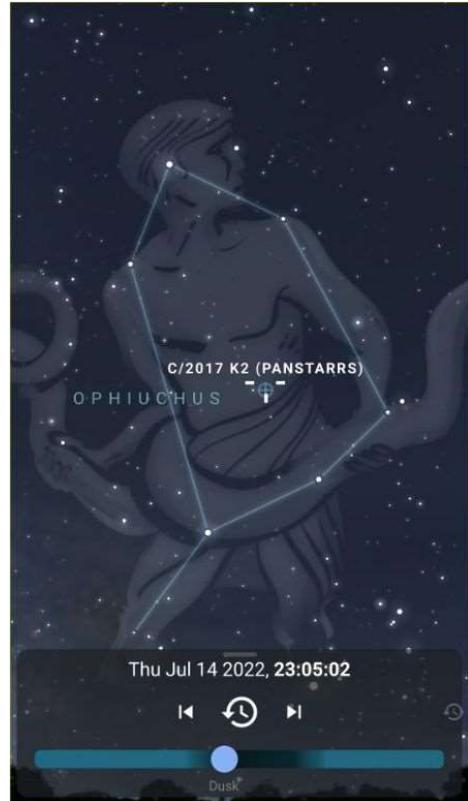
**67P/ Churyumov-Gerasimenko** (Чурюмов-Герасименко), Rosetta and Philae's comet should stay visible throughout the first few of months of 2022, quite high in the sky, doing a loop around the North of Cancer, as it drifts away from the sun again. This comet has been well behaved, but fairly faint, consistently reaching 10<sup>th</sup> magnitude.

We also have **C/2019 L3 ATLAS**, in Gemini. It is a little fainter than 67P, but not much. It passes towards the Milky Way and crosses the twins outline in February and March. It is close to the bright star Alhena in Gemini from 26<sup>th</sup> March – 2<sup>nd</sup> April and slow moving across the stellar background.

In April-May Comet **C/2021 O3 PanSTARRS** should be visible. It is predicted to approach magnitude 6.5, so not bright but not bad. It should be passing Mercury and the Pleiades on the weekend evenings of April 30 and May 1, low in the north west. It will fade and rise higher each night, passing the star o Persei near nebula NGC 1333, and appear to the right of the California nebula on the 5<sup>th</sup> May. The California nebula, NGC 1499, is very large and is not known to be visible by eye at all. It reaches a declination of 81½° on the 27<sup>th</sup> May but should be 4 magnitudes fainter. It will be slightly easier from Northern Declinations but for observers too far north, like the UK is, the summer twilight starts to interfere.

Also now, and in spring, is an old faithful comet **29P/Schwassmann-Wachmann 1**. It is a 15 year periodic comet that orbits solely outside Jupiter's orbit, with an aphelion of 6.25AU and perihelion 5.72AU. Despite staying so far from the sun, this 40 mile ice ball goes into frequent outbursts, of which it has undergone many in 2021 and is still bright from them all. It fluctuates between 18 and 10<sup>th</sup> magnitude and rotates in 57 days. It is classed as a Centaur. I mention it here, because while it orbits close to the ecliptic plane, this year it is at its furthest north in the sky. Just North of Taurus, flirting with Auriga. It does a retrograde loop each year, like any outer planet.

The comet I mentioned in the last magazine, **C/2017 K2 PanSTARRS**, unfortunately has not got a very unique nor memorable name. It is a very long term, big distant non-periodic comet. It starts the year in North Ophiuchus on the border with Hercules, and heads towards Altair in Aquila, not getting there, as it turns around in May and heads back through central Ophiuchus in July. It is very bright for its distance from the Sun, but should reach about 6<sup>th</sup> magnitude in June, staying fairly bright most of the year. It may fizzle yet, you never know. This could be the brightest comet of 2022.



Towards the end of the year, a new comet **C/2020 V2 (ZTF)** – this stands for Zwicky Transient Facility has been discovered and may brighten to 9<sup>th</sup> magnitude. It is visible all year, although terribly faint at the moment, at 17<sup>th</sup> magnitude. Moving through the main quadrilateral of the Plough in spring, it does a slow loop throughout the year and then crosses its path and heads even more northerly passing 5° from Polaris on the 20<sup>th</sup> December 2022.

## Meteors

The International Meteor Organisation have a useful document about 2022 meteor shower prospects here <https://www.imo.net/files/meteor-shower/cal2022.pdf>

IMO's highlights are more for scientific interest than great spectacles for the public, but occasionally these outbursts are worth watching out for. There are now many orbital predictions of meteor streams which really started during the Leonids 1998, by David Asher and co from Armagh Observatory, Peter Jenniskens of NASA SETI and the Finnish group of Esko Lyytinen who sadly died last year.

There is a potential outburst of the Tau Herculids on May 31<sup>st</sup> 2022. Good moonless conditions for the Quadrantids in early January (3-4). The Perseids (Aug 13<sup>th</sup>) are during full moon unfortunately but the Geminids are during a near last quarter moon, meaning the shower will be best earlier in the night (Dec 13<sup>th</sup>). Lyrids (April 22<sup>nd</sup>) occur after last quarter moon, as do the Orionids (October) and Leonids (November).

There is a potential appearance of meteors from minor planet 2005GY2 on May 15, from 10h20 54°.

## Planets

We start the year with Saturn then Jupiter disappearing into the evening twilight, and Neptune and Uranus remain visible for longer into the spring. Saturn, then Jupiter return in July early mornings, with Mars following after them. Mars brightens throughout the latter half of 2022, attaining a great northerly declination for good imaging high in the sky, while not being too small. In early September, it adds another red eye to the bull, Taurus. It reaches its closest in early December in Taurus, at magnitude -1.8 and diameter 17" and an altitude of 62°.

Venus doesn't make much of an appearance as it stays fairly low in the morning sky. Mercury makes a brief evening appearance around 9<sup>th</sup> January, around 26<sup>th</sup> April (a bit better), and a good morning appearance around 10<sup>th</sup> August. Mercury and Venus meet in the evening sky after Xmas 2022.

Vesta the asteroid that can appear brightest to the eye, reaches 6.0 magnitude near the Helix Nebula in Aquarius on August 20<sup>th</sup>, it is just 1.28 AU from us but is around for much longer either side.

On 7<sup>th</sup> Feb 2022, the moon passes very near Uranus at 20:33 and on the 14<sup>th</sup> Sep 2022, it occults Uranus at 23:26 BST as a gibbous phase, and reemerges a short while later. Mars is occulted by a bright Moon on the morning of 8<sup>th</sup> December 2022, while at its largest. We should see both disappearance and reappearance.

As usual, please use tools such as Stellarium, Cartes de Ciel, Sky Safari, The Sky, to help you find the usual deep sky objects. Heavens Above is useful for bright comets. The BAA Handbook, available at the observatory has many more details, ie moons of outer planets, faint asteroids and meteor peaks and charts and is worth looking at.



*Dan Self*

# 2021 Leonids Meteor Shower

The Leonid meteor shower is annually active in the month of November and it usually peaks around November 17<sup>th</sup> or 18<sup>th</sup>. The shower is called Leonids because it's radiant, the point in the sky where the meteors seem to emerge from, is at the head or 'sickle' of the constellation Leo the Lion.

The Leonids occur when the Earth passes through the debris left by Comet Tempel-Tuttle. The comet takes around 33 years to make one orbit around the Sun.

As the comet follows its path around the Sun, it leaves a path of tiny debris. The cometary debris enters our planet's atmosphere at speeds of up to 70 kilometres per second, vaporising and causing the streaks of light we call meteors.

About every 33 years (the period of Comet Tempel-Tuttle), the Leonids produce meteor 'storms' when hundreds or even thousands of shooting stars can be seen. Such storms were seen in 1799, 1833, 1866, 1966 and 1999-2001 (although the expected 1899 and 1933 storms were disappointing). The 1833 storm was particularly spectacular, with an estimated 100,000 meteors per hour. The 1999-2001 storms produced about 3000



Woodcut of 1833 shower.

The meteoroids left by the comet are organized in trails in orbits similar to, though different from, that of the comet. They are differentially disturbed by the planets, in particular Jupiter and to a lesser extent by radiation pressure from the Sun, the Poynting–Robertson effect, and the Yarkovsky effect.

The Poynting–Robertson effect, also known as Poynting–Robertson drag, named after John Henry Poynting and Howard P. Robertson, is a process by which solar radiation causes a dust grain orbiting a star to lose angular momentum relative to its orbit around the star. This is related to radiation pressure tangential to the grain's motion. This causes dust that is small enough to be affected by this drag, but too large to be blown away from the star by radiation pressure, to spiral slowly into the star. In the case of the Solar System, this can be thought of as affecting dust grains from 1  $\mu\text{m}$  to 1 mm in diameter. Larger dust is likely to collide with another object long before such drag can have an effect.

The Yarkovsky effect was discovered by the Polish-Russian civil engineer Ivan Osipovich Yarkovsky (1844–1902), who worked in Russia on scientific problems in his spare time. Writing in a pamphlet around the year 1900, Yarkovsky noted that the daily heating of a rotating object in space would cause it to experience a force that, while tiny, could lead to large long-term effects in the orbits of small bodies, especially meteoroids and small asteroids

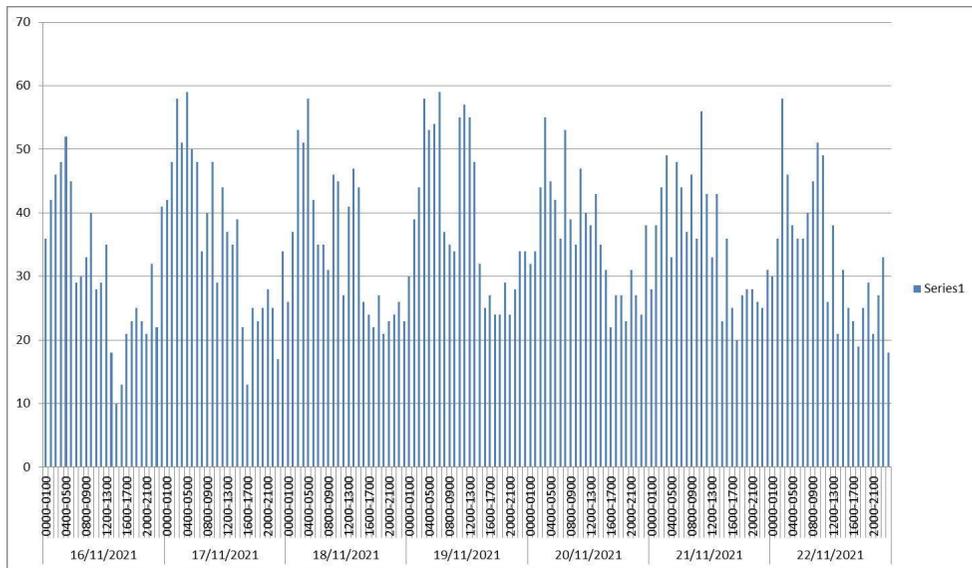
The consequence of the above two effects is that over time the stream of debris from the comet is spread out over a wider band and the meteor storm appears, from Earth, to be widened and have a less defined central peak. It is also possible that the peak itself may be shifted.

These trails of meteoroids cause meteor showers when the Earth encounters them. Old trails are spatially not dense and compose a meteor shower of a few meteors per minute. In the case of the Leonids, this tends to peak around 18<sup>th</sup> November, but some are spread through several days on either side and the specific peak changes every year. Conversely, young trails are spatially very dense and the cause of meteor outbursts when the Earth enters one.

## 2021 Observations.

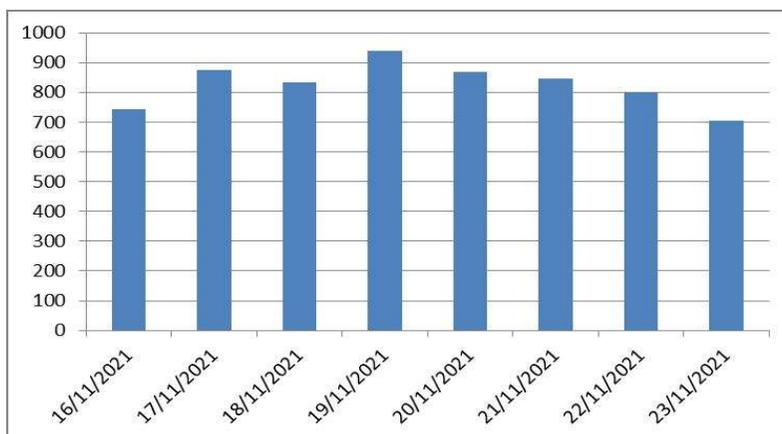
Due to the position of the Moon during the peak of the meteor storm (full moon November 19<sup>th</sup> : 08:57z). Visual and photographic observations were compromised.

Radio observations using GRAVES transmitter for forward scan radar observations showed:-

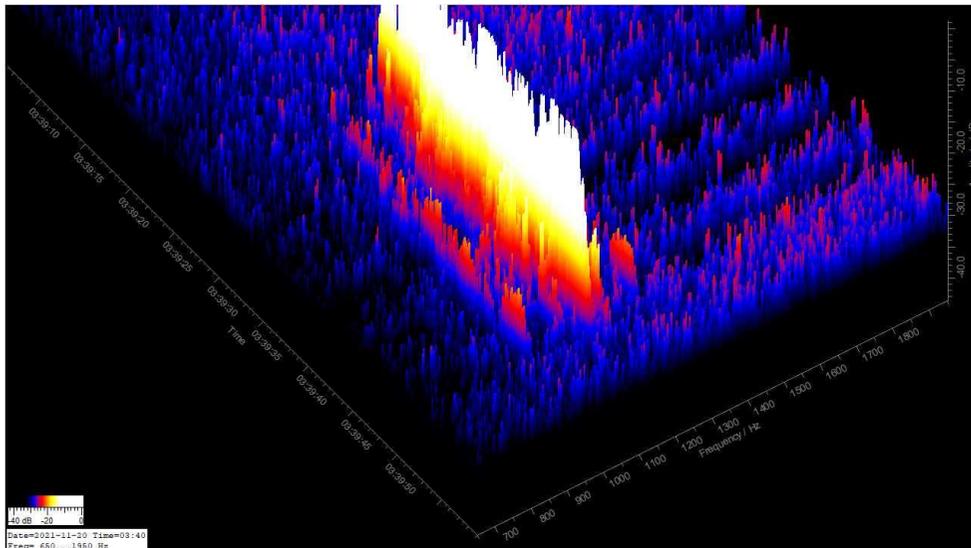


This shows a fairly even spread across the week shown here. Observations outside this period show only a slow build-up and decline.

Showing the daily rates



This shows that the peak appears to be on the 19<sup>th</sup> November. This is further shown as most of the larger echoes and high-speed echoes occurred on the 19<sup>th</sup> and 20<sup>th</sup> of November



I guess we need to look forward to 2032/2033 to see if the next pass gives a really good show!



2016 Leonids Meteor Shower

## Observing surprise 1999

Having been out cycling around Norfolk in the summer I had found the perfect spot to plonk a telescope and take photographs. It was a couple of concrete farmer's pads. One on nowhere lane near Reepham looked ideal. There was a farmhouse to the North and some distant telegraph poles but the surface was very convenient and the area mostly free from traffic.

The previous autumn I had started studying the upper atmosphere for my PhD, but I felt more belonging to the astronomy side of my research, which lay just beyond my remit. One November evening, it was cold and clear so I drove to the farm pad to photograph Orion. I waited until a few clouds had drifted past when I saw a red shaft of light appear in the East. A distant mast was up in that direction so I initially thought it was some activity from the industrial complex or that they had put up a search light or flare, but this was bright red. It was not vertical either. As I watched it intensified, the red colour getting stronger. Within a few seconds I quickly hypothesised it was aurora borealis.

"Look" "Wow" I said as I was in company. Then it faded before I could set up the lens and reappeared slightly differently positioned. To the north, all across the hemisphere (or quarter-sphere) were some greyish tall, vertical shafts of light, not dancing, but just slowly fading in and out like a slow motion distant Pink Floyd concert. I got snapping quickly with 30 second exposures on Konica ISO 3200 film.

Over to the North West was Lyra setting among a greenish hazy glow of excited oxygen emission I was later to learn. I captured it all, badly by today's standards, with my 58mm f/2 and 28mm f/2.8 + fish eye lenses. The images were grainy and trailed but for 1999 not bad! What a show! I finished the film and went back home excited.

Once home, in the city, practically the city centre we looked for more. Looking north behind houses and a bright streetlight I saw a rather spooky rapid blue/green flicker. It was quite shocking to see the movement. From the back garden, on sunloungers, we saw a red sheet extend to beyond the zenith and more southward even. Aurora reached 52 degrees N that night. It was so bright and obvious from 11:30 to midnight, we thought anyone walking home from the pub would notice it (and it was a Friday I believe). Not so! It didn't make the local newspaper so I could only conclude that most people just don't look up!

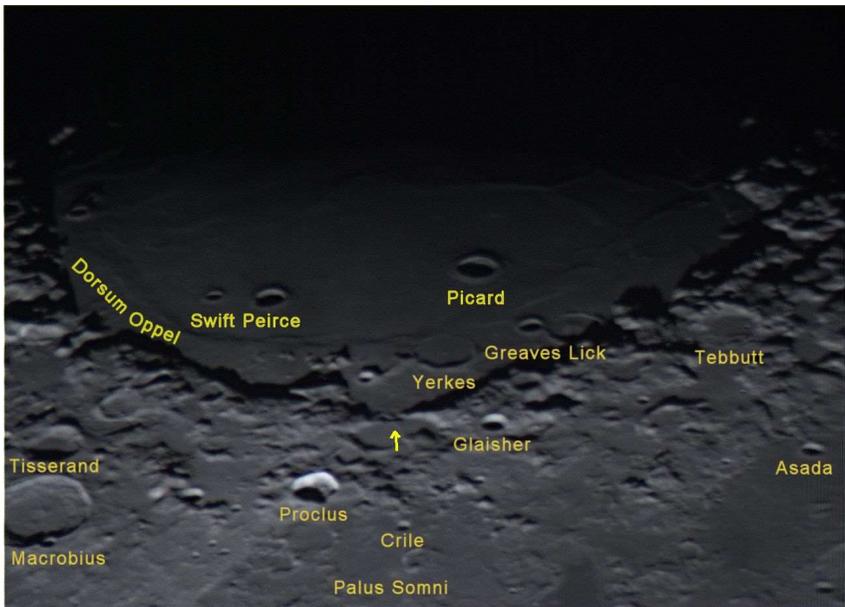
*Dan Self*

# Members Astro-photographs.

Dan Self



Ghost Nebula Cepheus, 20" Observatory telescope ATIK 383 camera



Mare Crisium.



Possible Aurora



Neptune and moons Miranda there at top

Mick Ladner



Open Cluster NGC7380 and The Wizard Nebula

40 x 180 sec lights @ -5 degrees c. Altair 72 EDF Scope. Altair Hypercam 269c PRO  
TEC cooled Camera. Altair MG32 Mini Guide Scope. Altair GPCAM 130m Guide  
Camera. iOptron CEM40 Mount. Pegasus ULTIMATE PowerBox V2 USB Control Hub  
Pegasus Motor Focus Kit v2. Universal Altair Skyshed Pier. Sequence Generator Pro  
Capture Software. Processed with PI and LR



Andromeda Galaxy our near neighbour in the cosmos even though it is 2.5 million light-years away.

Altair 72 EDF Scope. Altair Hypercam 269c PRO TEC cooled Camera

Altair MG32 Mini Guide Scope. Altair GPCAM 130m Guide Camera

iOptron CEM40 Mount. Pegasus ULTIMATE PowerBox V2 USB Control Hub

Pegasus Motor Focus Kit v2 Universal. Altair Skyshed Pier

Sequence Generator Pro Capture. 52 x 180 second subs @ -5 degreesC plus calibration frames. Processed with PI & LR

Andrew Luck



Roger Hyman



Pleiades (M45) taken tonight with William Optics GT71 and Altair 183C. 120 x 30 second exposures using SharpCap Pro 4.0. Processed with APP and Photoshop. No dark or flat frames used.



Moon(12th November). GT71 with ZWO ASI462MC.



Moon (15th November 2021) 20:45 UTC. 75% waxing gibbous. GT71, 68III reducer/flattener and ZWO ASI462. Captured using SharpCap 4.0 and processed with AS!3 (best 25% from 3,500 frames) and finished with Photoshop 2021 and Topaz Sharpen AI.

Malcolm James Dent.



Bi colour image of Ngc6960. Ha 1.5hrs O3 3.5hrs.



Aurora in Norfolk

Andy Weller



Horse Head and Flame nebula in Ha

Perry Warburton

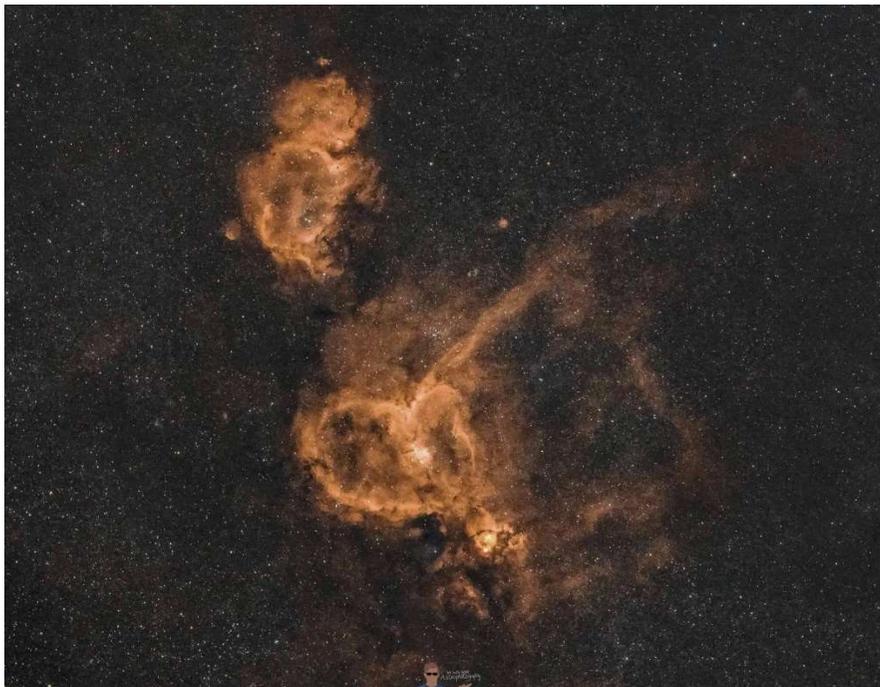


8.3h Ha @ 300s. 50 darks. 50 flats. 50 dark flats.

Telescope: TS Photoline 80mm f6 triplet. Mount: Skywatcher NEQ6 pro

Camera: ZWOASI 183mm

Michael Wilson



Canon 6D UV/IR cut filter mod. Astronomik 12nm Ha clip filter

📷 Samyang 135mm F/2.8. Sky Watcher Star Adventurer star tracker

📐 Manfrotto 055 tripod

97x60 second tracked light exposures, ISO 800, F/2.8

20x60 second dark exposures, ISO 800, F/2.8

50x1/500 second flat exposures, ISO 800, F/2.8

50x1/500 second dark flat exposures, ISO 800, F/2.8

50x1/4000 second bias exposures, ISO 800, F/2.8

Ha:

13x180 second tracked light exposures, ISO 3200, F/2.8

20x180 second dark exposures, ISO 3200, F/2.8

50x1/80 second flat exposures, ISO 3200, F/2.8

50x1/80 second dark flat exposures, ISO 3200, F/2.8

50x1/4000 second bias exposures, ISO 3200, F/2.8

Total combined integration time of 2 hours and 12 minutes

Stacked in DSS. Edited in Photoshop/Lightroom

Marianne Watts



# Invitation to Gresham Lectures

Dear Local Astronomy Society

I thought you and your members might be interested in these free public astronomy lectures held online by Professor Katherine Blundell and Professor Roberto Trotta in 2021-2.

## ASTRONOMY

### Cosmic Revolutions by Professor Katherine Blundell

[gres.hm/cosmic-revolutions](https://gres.hm/cosmic-revolutions)

This series will expound in context and in detail some key realisations about cosmic history that are now regarded as fundamental in the modern understanding of how the cosmos came to be, and of our place in it.

#### **Structures in the Universe**

Wednesday, January 19, 2022 6:00 PM [gres.hm/structures-universe](https://gres.hm/structures-universe)

Museum of London/ Online Or watch later

How did the cosmos transition into space characterised by galaxies in a plethora of different shapes of great beauty? This lecture will consider what happens when groups of galaxies interact with one another and what happens when these galaxies collide and merge.

#### **Magnetic Universe**

Wednesday, February 23, 2022 6:00 PM [gres.hm/magnetic-universe](https://gres.hm/magnetic-universe)

Museum of London / Online Or watch later

Magnetic fields have mysterious effects that can be dramatically counterintuitive, and they are ubiquitous throughout the Universe and can have influence on large scales. This lecture will explore how some of the exotic and energetic phenomena in the Universe can only be explained in terms of these magnetic fields that pervade space.

#### **Planetary Universe**

Wednesday, March 30, 2022 6:00 PM [gres.hm/planetary-universe](https://gres.hm/planetary-universe)

Museum of London / Online Or watch later

How can new worlds be discovered, and how many exo-planets might be out there? What does today's technology in astronomical observatories now enable, and what is it that holds us back from finding what is actually out there? What hinders us from pushing forwards the frontiers of space science?

#### **Life in the Universe**

Wednesday, June 1, 2022 6:00 PM [gres.hm/life-universe](https://www.gres.hm/life-universe)

Museum of London / Online Or watch later

How can life form in the Universe, and what are the necessary ingredients for habitability so that planets can sustain life? Can we expect life elsewhere in the solar system, or on exo-planets? This lecture offers a broader perspective from astrobiology, astrochemistry, and astrophysics on the habitability or otherwise of other planets beyond Planet Earth.

## The Frontiers of Knowledge by Professor Roberto Trotta [gres.hm/frontiers](https://www.gres.hm/frontiers)

We have progressed far in our understanding of the Universe, and yet so much is still tantalisingly unknown. What explains the accelerating expansion of the Universe? Can physics mend the broken Cosmic Distance Ladder? What is the future for life on our planet?

### **The Broken Cosmic Distance Ladder**

Monday, January 31, 2022 1:00 PM [gres.hm/cosmic-distance](https://www.gres.hm/cosmic-distance)

Barnard's Inn Hall/ Online Or watch later

Measuring distances to astronomical objects outside our Galaxy is a surprisingly hard challenge: it wasn't until 1929 that Edwin Hubble obtained proof that Andromeda is indeed a galaxy in its own right. Today, astronomers extend distance measurements in the cosmos to the edge of the visible Universe, building up a 'cosmic distance ladder' made of several rungs. This talk will explore a major conundrum of contemporary astronomy: as observations have become more precise, the distance ladder appears today to be broken.

### **The Future of Life on Earth**

Monday, May 9, 2022 1:00 PM [gres.hm/future-life](https://www.gres.hm/future-life)

Barnard's Inn Hall/ Online Or watch later

Although life is probably widespread in the universe, our pale blue dot, Earth, is the only known place harbouring intelligent life. Even if we manage to stave off extinction by climate change, avoid a nuclear apocalypse and the dangers of runaway AI, biological life on our planet will eventually come to an end in about 5 billion years' time. What are the astrophysical dangers to life on Earth, and the prospects for life's survival into the distant future?



# **BRECKLAND ASTRONOMICAL SOCIETY**

Charity No.1044478

[www.brecklandastro.org.uk](http://www.brecklandastro.org.uk)

**Affiliated to the British Astronomical Association and the Federation of Astronomical Societies**

Dr Dan Self, Chairman

[chairman@brecklandastro.org.uk](mailto:chairman@brecklandastro.org.uk)

## **OBSERVATORY RISK ASSESSMENT 2021**

This policy document applies to the aforementioned charity and covers all instances of normal use of the observatory building and equipment within it. All other statements of intent are laid out in the society's constitution.

The purpose of the society (Breckland Astronomical Society) is to promote and to advance public education in the Science of Astronomy and all branches of scientific research and in so doing the following policy statements are necessary.

Persons visiting are members and public of all ages by pre-arrangement, or on public open nights.

## Section 2 - Risk Assessment

<b>Hazards</b> <i>(The visit leader must identify any additional hazards relevant to the planned activity where applicable)</i>	<b>Risk Control Measures</b>	<b>Outcome risk rating</b>
<b>For external parties:</b> Safety whilst travelling to observatory.	Responsibility is with individual regarding transport.	Low
Lost people	A nominal roll should be available for parties with minors. Stay in groups and count in and out, especially risky when young children running around on dark field. Responsibility with teachers/akelas.	Tolerable
Pre-existing medical conditions	Visitors have been asked to bring with them anything they need with regard to medicine/ first aid training. DS is first aid trained as part of job.	Tolerable
<b>In the Observatory:</b>  Moving the telescope dome - Mechanical hazard from cogs and metal clips on dome motors and sliding parts.  Falling from dome.	Supervision is necessary to prevent visitors' fingers being caught in dangerous places before moving. Train supervisors. Gears are located in inaccessible places.  Signs to keep head out of opening while moving it. Failure of clips holding very difficult due to strong fastening.	Tolerable   Tolerable
Electrical hazards	All electrical circuits are protected by RCD trip switches, which have been checked. Equipment should only be used by trained demonstrators as PAT testing is not viable.	Tolerable
Light intensity from laser pointer, bright LEDs	A low power class 2 laser can be used to collimate scope, this should not be used during visits. An upper end- class 2 green laser is sometimes used for pointing out stars outside. This should NOT be	Low

	pointed near people, or planes, only switched on briefly and used by supervisors/demonstrators only. Laser is currently broken.	
Skin contact with dangerous chemicals	Fly spray, propanol, and cleaning fluid kept in cupboard in small quantities. Keep cupboards shut when visitors are present and supervise.	Tolerable
Standing in dome - Falling (height is 7 feet)	Shutter opening is guarded by 2 bars at child / adult heights. Limit numbers in dome 7 + supervisors can easily fit.	Tolerable
Standing in dark places - Stumbling in low light	Use dim red lights on floor to preserve night vision. Dim lights gradually.	Low
Climbing ladder in dark - Falling while viewing through telescope.	Ladder must be shown to people first, but enough light is available. Check for mobility difficulties.	Tolerable
Ascending stairs - Falling or being hit with trap door	Be sure demonstrator to go up first and lock door open. A knocking procedure is known if the door is shut.	Tolerable
Fire risk	Large items are not flammable. Mainly metal fixtures and fittings. Sources of ignition (sparks) are contained in electrical equipment. Flammable gases are not kept in building. Radio linked smoke alarms installed. Fire extinguishers available and annually checked. Call 999 in emergency. Can exit via dome opening in emergency.	Tolerable
Standing in dark cold field - frostbite	Weather could be freezing at this time of year. Warm clothes have been advised before trip. Heaters indoors if cold and keep a blanket at the observatory.  Trip hazard in dark. Torch guidance will be provided but is limited because of dark sky observing.	Tolerable
Child protection risks (under 18s)	Two adults should be available at all times. DBS checks are in place for INTO employee leading the visit. This visit is arranged in advance and INTO duty staff should be aware of the students' location. Students should have INTO's number. The organisation that runs the observatory, Breckland Astronomical Society, operates a child protection	Low

	policy. The committee are vigilant with regard to risks.	
<b>SARS CoVID19:</b> Airborne Transmission indoors	Ventilate. Open shutter and doors. Wear Masks as long as Covid is at large in the population, unless exempt.  Physically Distance 1m+.  Limit numbers to what national guidelines state at the time. Given limited space not many are allowed in at a time.  Provide outdoor activities, e.g. electronically assisted astronomy	Tolerable – as we have very good ventilation.
Outdoor transmission	Physically distance, however risk is found to be low outdoors. Follow national guidelines. Be mindful of face to face breath transmission.	Tolerable
Surface transmission	Sanitise hands on entry. Wipe surfaces. Use fresh eyepieces for each household.  Limit one to use of kitchen/bathroom area.  Only use disposable drinks containers and paper towels.	Low
Reporting	Sign in for track and trace purposes.	N/A

Trustees as of 16/05/2021 are: Dr Dan Self <sup>\*\*</sup>(Chairman), Andy Jones <sup>\*\*</sup> (Treasurer), Richard Harmon. Committee members (acting trustees): Rebecca Greef <sup>\*</sup>, John Copsey. Trusted supervising members: Mick Ladner, John Gionis, Peter Farmer, Andrew Luck, Chris Bailey.

\*DBS checked for day job. \*Frist Aid trained for day job

Signed.....

Chairman, Breckland Astronomical Society, UKCC 1044478.



# **BRECKLAND ASTRONOMICAL SOCIETY**

Charity No.1044478

[www.brecklandastro.org.uk](http://www.brecklandastro.org.uk)

**Affiliated to the British Astronomical Association and the Federation of Astronomical Societies**

Dr Dan Self, Chairman

[chairman@brecklandastro.org.uk](mailto:chairman@brecklandastro.org.uk)

## **RETURN TO HALL COVID RISK ASSESSMENT 2021**

The risk COVID poses to local residents is now much smaller, with up to a 1 in 1000 or less who catch COVID dying (source Tim Spector, ZOE). This is still an intolerable level of risk, however is not greater than a winter flu. As more are vaccinated and the longer we wait for the vaccines to take effect, and booster shots are given, this risk will reduce. If anyone is particularly vulnerable, eg has a respiratory disease, or a serious autoimmune disorder they may wish to continue to not attend in person. This would mean the risk of dying if the disease is caught reducing to a more Tolerable level. We will endeavour to livestream the talks from a tripod near the projection stand, although the service will not be as personal as zoom or google meet.

Hazards	Risk Control Measures	Outcome risk rating
<b>Spread of SARS COVID-19 delta variant by airborne transmission</b>	Limit numbers in hall to 40, it is a community building. Legally any number is allowed from July 19. Usually numbers are well below this, so will be a small risk.	Tolerable if we can keep doors open
	Physical distancing between bubbles, of 1 metre + not face to face. This is not enforceable, as it is not government guidelines. Space out chairs to fill room.	Chairs are all facing forward anyway so this works
	Do not come to the hall if displaying two or more COVID19 delta variant symptoms. These are (for vaccinated people, most common first): Headache, Runny Nose, Sore Throat, Sneezing, Persistent Cough or Loss of Smell. Fever (high temperature) is more likely to be a sign of COVID if unvaccinated.	
	Wear masks as a request. Again this is not enforceable as it is not government guidelines.	
	Ventilate hall. Easy when weather is warm, not ideal when cooler, so only applicable in August/September. The back door and bar flap may be a better option to use as a ventilation path in colder months.	
	Have a ventilation break at half time, open up all doors fully and have coffee then, in order to clear the hall from any possible airborne particulates (see below).	
<b>Spread of SARS COVID-19 delta variant by airborne transmission during coffee</b>	Masks have to be removed for coffee or a break for air. Or for those with breathing problems. Having coffee partly outside, we may not all fit, but any reduction in people density in the hall is a recommendation. This can be under a Gazebo erected by the fire doors, if weather is poor.	Tolerable if warm enough. Revise if case numbers climb, or weather worsens.
Spread of COVID-19 by Surface transmission	Sanitise hands on entry. Wipe surfaces. Washing hands a necessity after toilet use.  Surface transmission is a minimal cause of COVID spread however, so it is considered low risk to use	Low

	provided mugs again. However we must wash up mugs thoroughly.	
	Payment is still cash only (£2.50). The other method is by donating £2.80 to the Donate button at the website (add 30p for the PayPal costs). Raffle ticket prices to be added.  Surface transmission via coins and paper is a minimal cause of COVID spread.	Low
Outdoor transmission	Physically distance more than normal, however risk is found to be low outdoors. Follow national guidelines. Be mindful of face to face breath transmission. Note: if you can see where someone's vape is going you can catch airborne particles from their lungs. Note 2: Please keep vaping outside the hall.	Tolerable
Reporting	Signing in for track and trace purposes will be stopped from July 19. However records of numbers will be kept by the entry log book.	Not necessary

Trustees as of 16/05/2021 are: Dr Dan Self \*\*(Chairman), Andy Jones\*\* (Treasurer), Richard Harmon. Committee members (acting trustees): Rebecca Greef\*, John Copsey.

Signed.....

Chairman, Breckland Astronomical Society, UKCC 1044478.

## For Sale or Wanted

This section is for the sale of Astronomical items and any wants from members. Details of items for sale (With photographs where applicable) should be forwarded to the newsletter editor at [newsletter@brecklandastro.org.uk](mailto:newsletter@brecklandastro.org.uk)

It is suggested that a donation of 5% of the final sale price be given to the Society to assist with funds. If sellers do not wish to make their contact details public then please make this known to me and I will field any enquiries on a box number system. Please send any sales details to me before the 26<sup>th</sup> of the month for inclusion in the next issue.

Please ensure that if any item is sold by another means prior to publication that I am advised so it can be removed to avoid confusion.

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## **Equipment available for loan to Members**

As well as our fantastic library members of the society can borrow our equipment. Here is an equipment list that can be used or borrowed by members, subject to personal responsibility for replacement value. Discuss your plans with one of the regulars first, as it is not easy for beginners to use some of this kit. We are here to help show you how to use it, when the weather holds up, then you will need to sign it out and get approval by a member of the committee. We can discuss a reasonable term.

### **Refractors:**

William Optics Megrez 102 S.V. F7 D102mm f/7 and reducer to f/5.6 – this may be unavailable soon.

William Optics GT-102 2019 D102mm F703mm f/6.9

Vixen 4" Refractor f/9

### **SCT/Maks:**

Celestron C925 Starbright F10 SCT FL D234.95mm F2350mm f/10 Refractor – preferably this should not be taken off the premises.

Celestron C8 SCT D203.2mm F2000mm f/10 Refractor (orange tube)

Meade LX200R SCT D203.2mm F2000mm f/10

Konus Motormax-90 Maksutov-Cassegrain 90mm F1200mm f/13 #1795

Meade ETX125 D127mm F1900mm f/15 Maksutov-Cassegrain Reflector

#### **Mak-Newt:**

Skywatcher 190MN DS Pro Maksutov-Newtonian Optical Tube Assembly D190mm F1000mm

### **Dobsonians:**

Skywatcher Skyliner 200mm F1200mm Dobsonian Reflector

Helios D200mm F1000mm Dobsonian Reflector

8-inch Dobsonian (turquoise tube, hand-made)

### **Solarscope:**

Coronado Solarmax 40

Meade 8x50mm Guide Scope

### **Binoculars:**

Vanguard KR-7500 7X50mm Field 7 degrees Binoculars – a little out

Konus #2253 7x50 Field 6.8° Binoculars

Chinon RB Optics 8-20 x 50 HB Zoom Binoculars

Prinzlux 10x50 Binoculars – needs optically cleaning

## **Mounts:**

Berlebach Planet Tripod with Double Clamps  
Orange EQ4 telescope mount  
Skywatcher SynScan EQ5 Equatorial Mount & Tripod  
SynScan mount controller  
Meade LXD German Equatorial Mount & Autostar Controller  
SynScan mount controller  
iOptron IEQ45 Mount and Pier  
iOptron Go2Nova mount controller

## **Eyepieces:**

Tele Vue Delos 17.1mm 2"  
Antares Speers-Waler 4.9mm SWA Series 2 2"  
Antares Speers-Waler 9.4mm SWA Series 3 2"  
Meade Ultra Wide Angle 14mm 1.25/2"  
Antares W70 Series 8.6mm  
Meade Super Wide Angle 18mm 1.25"  
Celestron 32mm Plossl 1.25"  
Celestron 26mm Plossl 1.25"  
Antares 17mm Plossl FMC 1.25"  
Intes-Micro Q74 WA 21mm 1.25"  
Orion (Or) Circle-T 9mm 1.25"  
Vixen K 18mm 1.25"  
Fullerscope K 25mm 1.25"  
66 Ultrawide 20mm Long Eye Relief 1.25"  
Or 6mm 1.25"  
Plossl 40mm Multi-coated  
Plossl 17mm Multi-coated  
14mm (7mm 21mm) 1.25"  
Super 20mm 1.25"  
Soligor PE-6mm 1.25"  
Super Plossl 32mm 1.25"  
Lanthanum LV 2.5mm 45 degree 20mm 1.25"  
Televue 2x Barlow 1.25"  
Televue 2.5x Barlow Powermate 1.25"  
2x Barlow Lens  
Meade Telenegative 2x Barlow 1.25"

## **Telescope accessories:**

William Optics AFR-IV Adjustable Flattener Reducer  
Meade Zero Image-Shift Microfocuser  
Meade 4000 Series f6.3 Focal Reducer  
Meade 4000 series f3.3 CCD Focal Reducer with T-Adapter  
Celestron Reducer/Corrector f6.3 (Model: 94175)  
Tamron Adaptall-2 Custom Mount

## **Eyepiece accessories and filters:**

Meade Electronic Eyepiece  
Meade Illuminated Reticle MA12mm  
Celestron Radial Guider (#94176)  
Light Pollution Filter 1.25"  
Meade #908 O-III Nebular Filter  
Variable Polarizing Filter #3  
Baader Planetarium Contrast-Booster Filter (#2458360) 1.25"  
Celestron Colored Eyepiece Filters (#25 Red, #38A Blue, #47 Violet, #53 L Green)  
Baader G-CCD Filter 1.25" (Cat: 2458470G)  
Baader R-CCD Filter 1.25" (Cat: 2458470R)  
Baader B-CCD Filter 1.25" (Cat: 2458470B)  
Baader UV/IR Cut/L-Filter 1.25" (Cat: 2459207A)  
Baader H-alpha 7nm CCD Narrowband-Filter 1.25" (Cat: 2458382)  
Baader O-III 8.5nm CCD Narrowband-Filter 1.25" (Cat: 2458435)  
Baader S-II 8nm CCD Narrowband-Filter 1.25" (Cat: 2458430)  
Baader H-beta 8.5nm CCD Narrowband-Filter 1.25" (Cat: 2458425)  
Astronomik L-RGB Type 2c Filterset 1.25" (4 filters, Cat: 10220125)  
Astronomik CLS-Filter 2" (Cat: 10213200)  
Astronomik CLS-Filter 1.25" (Cat: 10213125)  
Astronomik CLS CCD-Filter 1.25" (Cat: 10208125)  
Star Analyser 100 (Model: PHEL-SA100) – produces spectra

## **Cameras:**

Atik Focal Reducer 58mm  
Atik 383L + FW 11/4"+Filters  
Atik Infinity Camera  
Atik 314L+ CCD Camera (SN11003041)  
Atik One 6.0 Monochrome CCD Camera (SN: 1191452-0093)  
Atik 460EX Color (SN21223-26)  
ZWO ASI290MM Mini USB 2.0 Monochrome Small Format CMOS Camera  
Imaging Source DBK21AU618.AS 640x480 USB2 planetary camera  
STV ('vintage video CCD AV camera) and Filter Wheel  
Astrovid 2000 ('vintage' CCD camera)  
Nikon D100 DSLR  
Sigma EX DG Macro 105mm 1:2.8 DLSR Lens  
Geoptik CCD Adapter x Canon (Model: 30A189)

## CONTACTS

**Chair** Dan Self  
**Contact** [chairman@brecklandastro.org.uk](mailto:chairman@brecklandastro.org.uk)

**Observatory/Visits** Mick Ladner  
**Contact** [visitors@brecklandastro.org.uk](mailto:visitors@brecklandastro.org.uk)

**Webmaster** Andrew Luck (temporary)  
**Contact** [webmaster@brecklandastro.org.uk](mailto:webmaster@brecklandastro.org.uk)

**Newsletter** Chris Bailey  
**Contact** [newsletter@brecklandastro.org.uk](mailto:newsletter@brecklandastro.org.uk)

**Membership/Treasurer** Andy Jones  
**Contact** [treasurer@brecklandastro.org.uk](mailto:treasurer@brecklandastro.org.uk)

**Secretary** Rebecca Greef  
**Contact** [secretary@brecklandastro.org.uk](mailto:secretary@brecklandastro.org.uk)

**Please check with any of the contacts in bold before visiting the observatory. Please ensure you are wearing appropriate footwear and clothing and bring a torch (preferably one showing a RED light)**

## Breckland Astronomical Society Events – Winter 2021 Spring 2022

7:30pm Great Ellingham Recreation Centre, Watton Road, Great Ellingham, Attleborough, Norfolk

**Entry £2 u18s £1.** Free livestream available.

Friday, December 10 <sup>th</sup>	<b>“Star Life” (note calendars for sale)</b>	Michael Poxon and Shaun Reynolds
Friday, December 31 <sup>st</sup>	<b>Public Open Night</b>	Observatory
Friday, January 14 <sup>th</sup>	<b>The Moon – Did we Go? Yes!</b>	Andrew Mowbray (remote)
Friday, January 28 <sup>th</sup>	<b>Public Open Night</b>	Observatory
Friday, February 11 <sup>th</sup>	<b>The Zooniverse</b>	Professor Chris Lintott
Friday, February 25 <sup>th</sup>	<b>Public Open Night</b>	Observatory
Friday, March 11 <sup>th</sup>	<b>TBA</b>	
Saturday, March 2	<b>Star Party (main night)*</b>	Haw Wood Farm
Friday, March 25 <sup>th</sup>	<b>Public Open Night</b>	Observatory
Friday, April, 8 <sup>th</sup>	<b>From the Big Bang to the Periodic Table</b>	Dr Richard Miller, Miller-Klein Assoc.
Friday, April 29 <sup>th</sup>	<b>Public Open Night (last of the season)</b>	Observatory

Friday, May 13th	<b>The Moon (+AGM)</b>	Jerry Workman
<p>* Haw Wood Farm Caravan Park, Hinton, Saxmundham, IP17 3QT. <a href="http://www.hawwoodfarm.co.uk">www.hawwoodfarm.co.uk</a></p> <p>to book: <a href="mailto:info@hawwoodfarm.co.uk">info@hawwoodfarm.co.uk</a> 01502 359550. £12 per pitch per night subject to updates</p>		