Spring 2020 Number 27

Kielder Observatory Newsletter

NEWS
Covid-19 closure

NIGHT SKY
Highlights May/June/July

SCIENCE
Exoplanets/ the legacy of Spitzer

OBSERVING
Comet Atlas

EDITORIAL

With the observatory closed, and everyone having to observe from their back gardens, we are living in strange times. And we are not the only one - most professional telescopes throughout the world have been closed for the last month or so. Nevertheless, we have put together a bumper edition for you to read, with 36 pages instead of the usual 28. Our Treasurer, Trevor Robinson, provides a detailed insight into exoplanets, whilst Robert Williams looks at the legacy of the Spitzer Space Telescope. Meanwhile, Helen McGhie brings us up to date on her STEAM project.

Nigel Metcalfe

Editors: Nigel Metcalfe & Robert Williams

newsletter@kielderobservatory.org

Kielder Observatory Astronomical Society

Registered Charity No: 1153570.

Patron: Sir Arnold Wolfendale 14th Astronomer Royal

Kielder Observatory Astronomical Society is a Charitable Incorporated Organisation. Its aims are to

* Promote interest in the science of astronomy to the general public
* Facilitate education of members of the public in the science of astronomy
* Maintain an astronomical observatory in Kielder Forest to support the above aims

https://kielderobservatory.org

E-mail: chairman@kielderobservatory.org

secretary@kielderobservatory.org

admin@kielderobservatory.org

KIELDER OBSERVATORY
Infinite Inspiration

Front cover: Milky Way over the Observatory by Adam Shore.
Rear cover: Observatory silhoutte, Dan Monk.

KOAS NEWS

In our last newsletter, we outlined some of the exciting new events we'd been planning for our forthcoming season, and were looking forward to embracing an exciting future of increased outreach and collaboration.

Now - only a few weeks later - we find ourselves living in interesting times! The Observatory is closed temporarily but we have seen an explosion of grass-roots astronomy, with many more people having the time to be in their back gardens and look up at the stars, and the team is busy transforming our service delivery with new digital content and new ways of interacting via social media.

Our financial reserves may be limited, but prudent financial planning, coupled with the inexhaustible enthusiasm and innovation of our amazing team of staff and volunteers, and the impressive support we've experienced from partners and customers alike, means that we will continue to create moments of inspiration for people of all backgrounds and abilities, and this will only increase once we re-open our much loved Observatory buildings.

We give a brief insight into our preparations for our changed world in the next section below, but will provide further details as the future comes more sharply into focus. We’d therefore encourage you all to keep an eye on our social media and on our website (which is still taking bookings for the future, by the way!).

Meanwhile, we send our very best wishes to all our readers and hope that the information provided below will help to keep you inspired by the wonders of the universe, while we seek a path together through the current health crisis.

Peter Standfield (Chair)

OBSERVATORY NEWS

The Milky Way seen above Kielder Forest at the entrance to the Observatory track.

As you know, like most other businesses we have had to temporarily close the Observatory site to comply with public health guidelines. We have been overwhelmed by the support we have received by email and phone when speaking to customers who had tickets booked for the closure period - everyone has been so understanding and supportive and determined to visit us when we can safely re-open.

Unfortunately we are not currently able to process and post merchandise orders as the office is closed for the time being. However, our online shop is still available so if you'd like to pre-order something now the order will go through and we'll get this packed and shipped to you first thing when we are back in the office. Thank you for your patience and your support!

We are ready to re-open at a moment's notice, either with our usual events or with reformatted events to accommodate social distancing. Be ready to book! Our winter calendar is now available for booking on our website - https://kielderobservatory.org/our-events - just scroll through to the relevant month and take your pick! We have created plenty of new events to whet your astro-appetites and will be featuring these on our social media soon. We are also creating relaxed events for people with different needs and abilities

- watch out for those coming soon.

I am sure some of you saw our Astronomer on Call series on Facebook - a big hit with kids of all ages and one we will repeat! Look out for our Locked Down Astronomy Challenges... if we are feeling generous, we might give out the secret to our famous hot chocolate...

We have taken the opportunity to spruce up the Observatory to within an inch of its life - much sanding, painting and varnishing have been going on (within strict social distancing rules of course), it's a full-on facelift!

We are also working hard to create a "virtual observatory" with plenty of content available, either free or paid-for. Given the circumstances we will also be making some content available to hospitals, care homes, schools, prisons, arts venues and organisations, the hospitality industry, in fact any organisation, group or individual who would welcome a moment of Kielder inspiration amidst all this uncertainty. If lock down continues, we will also look to implement a rolling programme of loaning out (suitably cleaned) telescopes and a free remote delivery astronomy session for more isolated groups.

We are working hard to make sure we can connect with as many people as possible whether online or at the Observatory itself. We are a charity, and we reply on our income from the public - every ticket you buy, every bit of Gift Aid we receive, every donation, every item of merchandise purchased goes directly back into helping us inspire more people with the wonders of the cosmos. If you would like to donate to us, at any time, but in particular during the current health crisis, please visit https://kielderobservatory.org/support-our-work/donate

Not been to Kielder Observatory yet?
Then why not book one of our events for you or your family?
Advanced booking is essential. Weekend events can fill up several weeks in advance. Please book online at https://www.kielderobservatory.org/our-events/ .
We can also be contacted at admin@kielderobservatory.org

Reaching out!

One of the most important things I want to achieve as CEO of Kielder Observatory is to enable as many people as possible experience “the Kielder moment”. The Kielder moment is unique, the moment that our guests experience when they look up at the glittering skies and something clicks into place – a realisation that we are all completely connected to this vast cosmos yet utterly unique within it. This moment is an engine for change and highlights the power of astronomy to inspire people to make a difference.

Yet far too many people cannot access that moment and that’s not good enough. We must find a way to deliver that moment to people who can’t come to us. Whether that is developing ongoing learning for people in care homes, helping cancer patients through treatment, working with excluded children, or developing materials tailored to different needs and abilities, it needs doing.

And you can help us make a difference.

To raise funds for this important work we have set up three ways to give to make it as easy and as convenient for you as possible: via text, via Paypal and when you shop online.

Every pound does indeed count!

Text Giving
Text INSPIRE to 70470 to donate £5 (texts cost £5 plus one standard rate message and you’ll be opting in to hear more about our work and fundraising via telephone and SMS. If you’d like to give £5 but do not wish to receive marketing communications, text INSPIRENOINFO to 70470). You’ll also get the option to turn this into a monthly donation.

Paypal Giving Fund
Easy donations via https://www.paypal.com/fundraiser/charity/132627

You can also support us when you shop!
Make Kielder Observatory your favoured charity at **Amazon** via this link https://smile.amazon.co.uk/
The Giving Machine offers you the option to donate immediately with no registration. Or sign up to donate via online shopping at Ebay, Etsy, M&S, Tesco, Boots and hundreds more! https://www.thegivingmachine.co.uk/causes/kielder-observatory-astronomy-society/

Thank you for your support - it will mean the world to someone somewhere.

Catherine Johns, CEO

Creative observations and snoozing under the stars

An update on my project with Kielder Observatory ...

Installation shot, Observe, Experiment, Archive.

In the Winter 2019/20 newsletter, I introduced the research aims of my arts-based PhD at the University of Sunderland, which I am undertaking in partnership with Kielder Observatory. My article reflected on the cultural connectiveness of astronomy and photography, and my new experiences of travelling to, and dwelling in the wild, dark skies at Kielder. Since then (prior to Coronavirus lockdown measures), it had been a busy few months: my photographic work was exhibited at Sunderland Museum and Winter Gardens, I shared my Kielder work with other arts and humanities research students at the British School at Rome and I spent an action-packed, but peaceful five night stay in the Kielder Observatory's 'snooze pod' temporary accommodation!

Curated by the North East Photography Network (NEPN) at Sunderland Museum

and Winter Gardens (15th Nov ‘19 – 5th Jan ‘20), Observe, Experiment, Archive explored “[…] how contemporary photographic artists can respond to both scientific innovation and historical collections” (Sunderland Culture, 2019). Eight photographic artists displayed different explorations of science—from an interrogation of archiving methodologies (Liza Dracup, Robert Zhao Renhui), to visualisations of scientific interventions in healthcare or agriculture (Sophie Ingleby,

Insect wings, c.1840. William Henry Fox Talbot.

Maria McKinney). My photographic work ‘Wanderers’, ‘Anatomy of a Northern Astronomer’ and ‘Dark Adaptation’ used elaborate museum display techniques to question the relationship between scientific illustration and the physical experience of astronomical observation in Northern England.

Early in its invention, photography was recognised as a new, objective way of visualising science. Its mechanical means for creating images (as an alternative to technical drawing) were deemed a breakthrough for capturing precise copies

Family photograph.

of objects in nature—revealing everything from complex snowflake crystals to the ancient light of distant stars. Despite their best efforts to be visually impartial, these ‘photographers of science’ tended to visualise their subjects according to personal aesthetic preferences, capturing objects under certain lighting conditions, with preferred compositions and perspectives; images were not without bias. Daston and Galison (2007, p. 17) have suggested that:

“To be objective is to aspire to knowledge that bears no trace of the knower, knowledge unmarked by

prejudice or skill, fantasy or judgement, wishing or striving. Objectivity is blind sight, seeing without inference, interpretation, or intelligence.”

It is interesting to consider the idea of ‘objectivity’ in relation to the conventional astro-photograph, where an extended camera exposure, specific composition and post-production editing capture a portion of the sky through a very subjective process, despite that they may have been inspired by the images taken by others. One should remember how the

‘Anatomy of a Northern Astronomer’, in Observe, Experiment, Archive.

position of the astro-photographer is key to the production of their work and that each shot taken was captured from a specific location on Earth, at a certain moment (or in the case of stacked images, a collection of moments) in time.

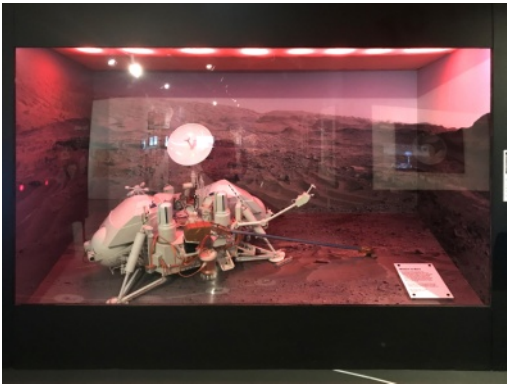
Perspective is everything to the photographer and that is why it cannot be an unbiased, objective practice. Despite this, the brief moment of confidence in the mechanically-objective photograph really fascinates me, particularly as we continue to hold great trust in pictures—for instance, I see happy childhood shots of my brother and myself smiling together in family albums, like we never argued! My parents carefully captured the right moments, excluding the sibling rivalry that most-likely continued seconds after the shutter had released. Looking back at these images, my pre- and post-shutter memories have faded, and any bickering is forever forgotten.

My work ‘Anatomy of a Northern Astronomer’ appropriated a pseudo-scientific museum-style vitrine display of 40 photographs. Experimenting with objective presentation, my intention was to create work that looked beyond the

‘Dark Adaptation’, in Observe, Experiment, Archive.

STEAM SLOT

glossy surface of astro-photography, investigating the personal inspirations and night-time encounters had by



'Mission to Mars', part of Hello Universe, National Science and Media Museum, 19 July 2019 – 22 January 2020.

astronomers at Kielder. The images illustrated the optical tools, clothing and overnight supplies required for an evening of dark sky observation, and a number of astronomy-related objects that reveal our cultural fascination with outer space. Instead of illustrating a fantastical representation of the night sky, in emulating the images that already exist, I wanted to flip the camera focus back at ourselves, as observers of a complicated universe that we try to make sense of through man-made scientific instruments, science-fiction stories and museum dioramas. Some of you kindly gave time to talk to me about your astronomy experiences and inspirations for stargazing, which included everything from battles of car breakdowns to encounters with thieving foxes at Kielder Campsite! Thanks again for sharing your stories with me.

My large-scale, almost theatrical photograph 'Dark Adaptation' (see page 8) presented a car park captured at night, a rocky landscape lit by the glow of artificial red light. To the analogue photographer (or those familiar with the TV crime scene drama), this hue is reminiscent of the ruby glow of the black and white darkroom, the stable conditions required for one to develop images under light-sensitive conditions. To the astronomer, red light maintains the nocturnal conditions for a sensitised visibility of the stars, a safe alternative to the white light that immediately blinds night vision. By photographically capturing the car park where guests eagerly await the night's activities at Kielder Observatory and printing it at almost life-size, the landscape is transported from a topological reality to a dramatic representation. On entry to Observe, Experiment, Archive, the audience was confronted by an almost Martian landscape, a life-size recording of a place

conquered by the camera, reminiscent of the rover captured images that are transmitted to Earth from the red planet. Exhibited in Sunderland Museum and Winter Gardens (a visitor attraction containing local heritage and educational curiosities), 'Dark Adaptation' became a museum diorama, similar to the 'Mission to Mars' display that was exhibited at the National Science and Media Museum, Bradford, a large, immersive presentation of Mars, complete with a 1:2 scale model of the Viking Lander, sand and images of the red planet. Despite its man-made construction, the scene can only exist as an elaborate elsewhere for imaginative contemplation, in order to inspire the scientists of the future. However, for Kielder, the staged adaptation of the rocky ground in 'Dark Adaptation' presents a tactile reality that one may step upon, accessing the cosmos through the magic of the observatory. Natasha Lund (Arts Programme Lead at Kielder Observatory) wrote a thoughtful blog in response to my work at the exhibition, which I recommend reading:
https://kielderobservatory.org/news/latest-news/148-observe-experiment-archive

As a fine-art researcher exploring photography's relationship with astronomy, it is vital to immerse myself in the subject. I therefore decided to participate in a five night on-site residential during February this year, where I packed enough food, clothing and rolls of medium-format camera film to sustain a stay in one of the Snooze Pods,

Artist residency, February 2020.

the temporary staff accommodation located in the observatory's car park. Well, what an experience! Immersing myself in the Kielder culture was a really useful research method for learning more about the organisation, where I engaged in the daily events (including those at Kielder Castle) and spent much time photographing the observatory's interior: the turrets, equipment and internal structure of such a breath-taking building. The weather was typically British and inconsistent: it sleeted, was blustery, rained, the sun shone, snow called off a day of events and the clouds parted for

only one night of stargazing, but overall, it was fantastic. For five nights, I slept under the thick expanse of night at Kielder, something extraordinarily different to the faint glow of orange streetlight that usually spills through my bedroom window in Manchester.

In addition to learning an abundance of space-related facts, I witnessed something even more fantastical: the magic of people coming together, eagerly investigating cosmic phenomena with one another for an immersive three hours. Despite the failure of the cloudy weather to let-up, or differences in background or scientific understanding, the visitors were visibly captivated, by the staff-storytellers who took them on a journey beyond the usual focus of our own existence. Every night, there was a buzz about the place. It was wonderful to talk to so many people - from the daytime visitors, to the nocturnal explorers of night. Thank you to the team at Kielder for making me feel so welcome, and to the visitors who kindly told me about their experiences of astronomy. These conversations, alongside the photography and film I shot, will contribute to the next stage of my PhD research, including a short film and a photography sound-trail on site at the observatory. Watch this space…

Follow my research blog for updates on the project: www.invisiblestargazing.blog

References:

Daston, L. and Galison, P. (2007) Objectivity. 1st Edition edition. New York: Cambridge, Mass: Zone Books.

Hello Universe (2019-20) [Exhibition]. National Science and Media Museum, Bradford. 19 July 2019 – 22 January 2020.

Observe Experiment Archive (2019-20) [Exhibition]. Sunderland Museum and Winter Gardens, Sunderland. 15 November 2019 – 5 January 2020.

Sunderland Culture. (2019) Observe, Experiment, Archive. Available at: https://sunderlandculture.org.uk/events/observe-experiment-archive/ (Accessed: 10 February 2020).

Helen McGhie

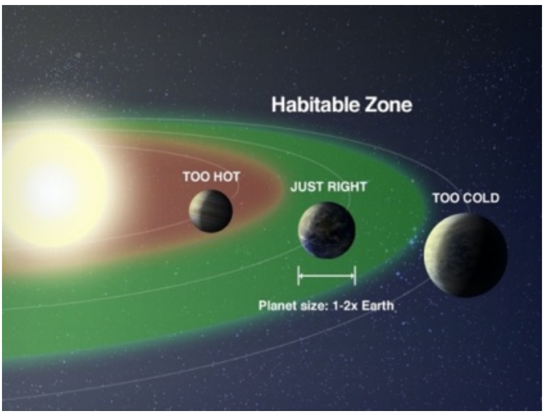
Exoplanets

Extrasolar planets, known as exoplanets, are planets outside of the Solar System. Scientists and science fiction writers have for hundreds of years speculated that there were such planets, but it is only the past few decades that their existence has been confirmed. The search for exoplanets is now a major area of study in astronomy and astrophysics, and there have been a number of space missions dedicated to their discovery.

A possible exoplanet was observed in 1917, orbiting the star Van Maanen 2, but it was not documented as such. A stellar spectrum was produced, which was thought to be that of an F-type main sequence star. However, it is now believed that the spectrum could have been the result of a nearby exoplanet which had been torn apart by gravitational forces, and then collapsed onto the star.

The first confirmed detection of an exoplanet was in 1992, when a number of planets were discovered circling a pulsar, and the first exoplanet orbiting a main sequence star was observed in 1995. This was a giant planet circling the star 51 Pegasi, with an orbit of just 4 days.

Some exoplanets have been discovered by direct telescopic imaging, but most have been found by other methods, of which the most productive have been the transit and radial velocity methods. Very recently, researchers have observed planets in another galaxy using a method known as gravitational microlensing.



As of 2 April 2020 there are 4,098 confirmed exoplanets in 3,139 stellar systems; there are multiple planets in 691 systems. It is believed that around 20% of stars like the Sun have a potentially habitable Earth-sized planet in the so-called habitable zone, with perhaps some 11 billion potentially in this category. The habitable zone is where there is the possibility of liquid water on the planet's surface.

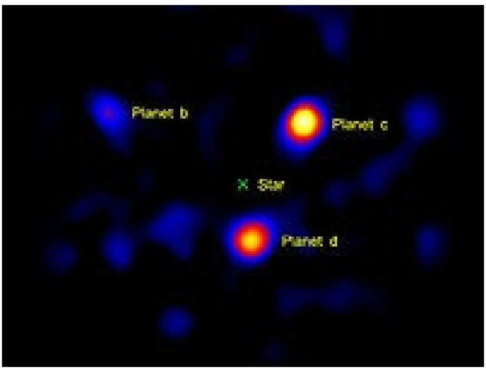
https://exoplanets.nasa.gov/what-is-an-exoplanet/how-do-we-find-habitable-planets/

SCIENCE SLOT

The closest exoplanet is Proxima Centauri b, which is 4.2 light years away, and the planet with the highest Earth Similarity Index (ESI) is Teegarden b, which is 12 light years away, with an ESI of 0.95.

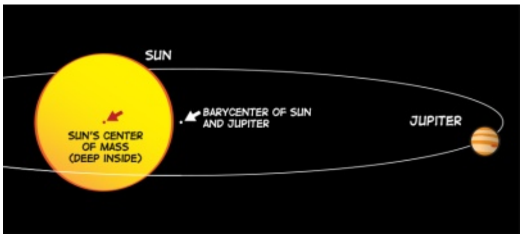
METHODS USED TO DETECT EXOPLANETS

Direct Observation:
The light from planets (usually reflected light from the star they orbit) is difficult to observe because it is much fainter than the light from the star. However, it is possible to make such observations if the planets are very large and the star is relatively close to the Sun. The diagram below shows three known planets of the star HR8799, as imaged by the Hale Telescope, with the light from the central star blanked out.



http://www.nasa.gov/topics/universe/features/exoplanet20100414-a.html

Radial velocity measurements:
You might think that a planet simply orbits around its host planet. However, the motion is more complicated than that; the planet and the star both circle a point known as the centre of mass of the system, otherwise known as the barycentre of the objects. This centre of mass is usually very close to the star, and where the star is very large and the planet is very small with an orbit close to the star, the centre of mass can sometimes actually be below the star's surface. The diagram below illustrates the barycentre for the Sun-Jupiter system, showing that the centre of mass is very close to the Sun.

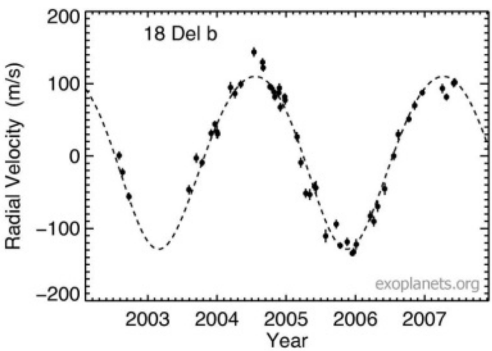


https://spaceplace.nasa.gov/barycenter/en/

If the exoplanet and its host star are more or less in the same plane when viewed from Earth, then an observer would see that the star's radial velocity relative to the Earth will increase or decrease as it orbits the centre of mass. This is sometimes called the Doppler wobble; it will cause

Doppler shifts in the stellar radiation we observe, and from those shifts we can deduce the presence of an orbiting star. Large planets can be observed circling stars at distances of up to a few thousand light years; smaller planets are more difficult to observe because they cause a smaller change in the star's radial velocity. Using current technology, the radial velocity method can only detect Earth-mass planets if they are in small orbits around small stars.

The plot below shows the Doppler wobble which reveals the existence of 18 Del b.



This plot was retrieved from the Exoplanet Orbit Database and the Exoplanet Data Explorer at exoplanets.org, maintained by Dr. Jason Wright, Dr. Geoff Marcy, and the California Planet Survey consortium.

This method, more properly known as Doppler spectroscopy, was until about 2012 the one that discovered the most exoplanets. However, since then, with the launch of the NASA Kepler mission, the most successful detection method has been the transit method.

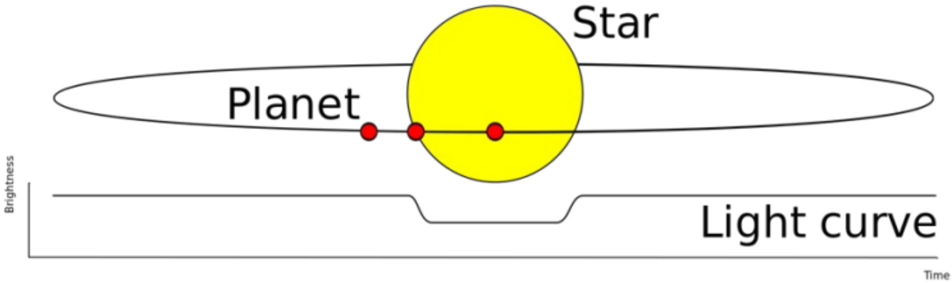
Transit Method:

The Kepler space telescope was launched on March 7, 2009. Its purpose was to survey part of the Milky Way to discover exoplanets of around Earth's size, orbiting their host stars in or close to the habitable zone. After nine years of operation, the telescope exhausted its supply of reaction control system fuel, and was officially retired in October 2018.

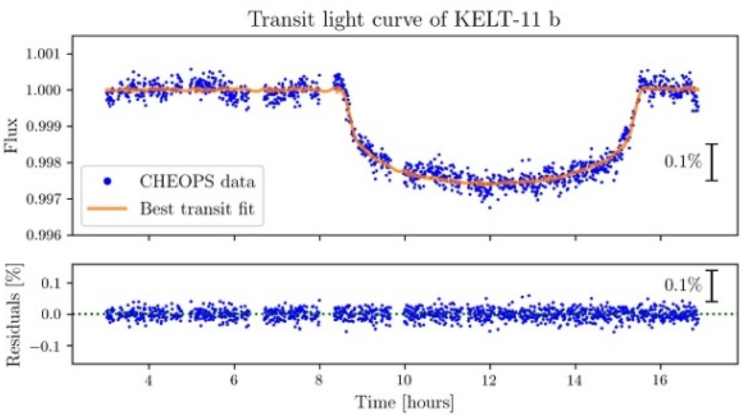
Kepler's only scientific instrument was a photometer monitoring the brightness of some 150,000 stars in a fixed field of view (the short side of the Summer Triangle, an area slightly larger than your palm held out at arm's length). This information was transmitted to Earth and then reviewed to detect regular dimming caused by exoplanets moving across the face of the host star. Such observations can only be made for planets having orbits edge-on to the Earth.

The main features of a transiting planet observation are shown on the next page, together with an example of an actual light curve, obtained by the European Space Agency CHEOPS mission.

SCIENCE SLOT



Inspired by image at http://www.iac.es/proyect/tep/transitmet.html, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=487277



Date: 16 April 2020

Satellite: CHEOPS

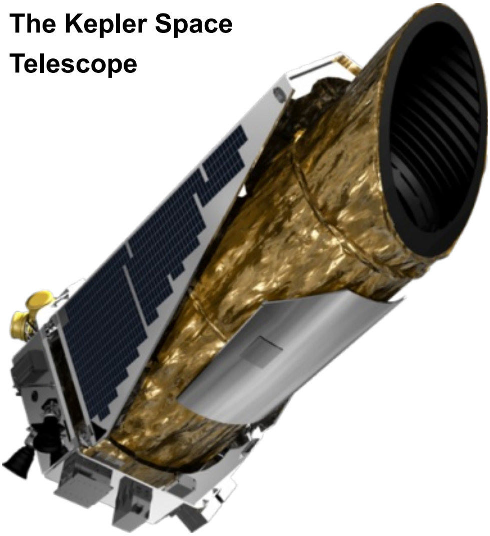
Copyright: CHEOPS Mission Consortium

In February 2014, NASA announced that Kepler had discovered 715 newly verified exoplanets orbiting around 305 stars, and in 2015, NASA revealed Kepler-452b, a near-Earth-size planet orbiting the habitable zone of a G2-type star. This is the closest to an Earth-Sun "twin" system ever found. In more than nine years of operation, the Kepler Telescope observed 530,506 stars and detected 2,662 planets.

In January 2020, the discovery of TOI 700 d was announced. This is the first Earth-sized planet in a habitable zone detected by TESS, the Transiting Exoplanet Survey Satellite. This space telescope, launched in April 2018 uses the transit method to search for exoplanets over an area 400 times larger than that covered by the Kepler mission. By 19 April 2020, TESS had identified 45 confirmed exoplanets, and 1,799 candidates.

As of January 2020, Kepler and TESS had identified 4,374 planetary candidates not yet confirmed, of which some are almost Earth-sized in the habitable zone.

The Kepler Space Telescope



NASA - https://science.nasa.gov/toolkits/spacecraft-icons (image link), Public Domain, https://commons.wikimedia.org/w/index.php?curid=76268556

A major feature of the transit method is that the lightcurve can determine the size of the exoplanet. If it is also possible to make a radial velocity observation, then the planet's mass can be calculated. Thus the planet's density can also be calculated, leading to an assessment of the planet's physical characteristics.

Information about some of the planet's characteristics can be deduced by using Kepler's third law of motion, which is derived from Newton's law of universal gravitation and Newton's second law of motion. When a transiting exoplanet is observed, the orbital period can be deduced by measuring the time between transits. Astronomers usually derive a value from several transits. This orbital period is related to the semi-major axis of the planet's orbit and the masses of the

CHEOPS (**CH**aracterising **E**x**OP**lanets **S**atellite), which was launched on 18 December 2019, is a European Space Agency space telescope which is intended to measure the size of known extrasolar planets, which in turn will allow estimates to be made of their mass, density, composition and formation.

Artist's impression of CHEOPS. Credit: ESA/ATG medialab

planet and the host star by Kepler's third law. This can be expressed as

$$\frac{a^3}{P^2} = \frac{G(M_* + M_p)}{4\pi^2}$$ where

a = semi-major axis
P = orbital period
G = Univeral Gravitiational Constant
M_* = mass of host star
M_p = mass of exoplanet

Usually, the stellar mass is much greater than the planet's mass, and a reasonable estimate of the star's mass can be deduced from its spectral type, and therefore we can get a reasonable approximate value for the semi-major axis value:

$$a \approx \left(GM_*\left(\frac{P}{2\pi}\right)^2\right)^{1/3}$$

Once a value has been obtained for the semi-major axis, together with assumptions deriving from the star's spectral type, it can be decided for example whether or not the exoplanet lies within the habitable zone.

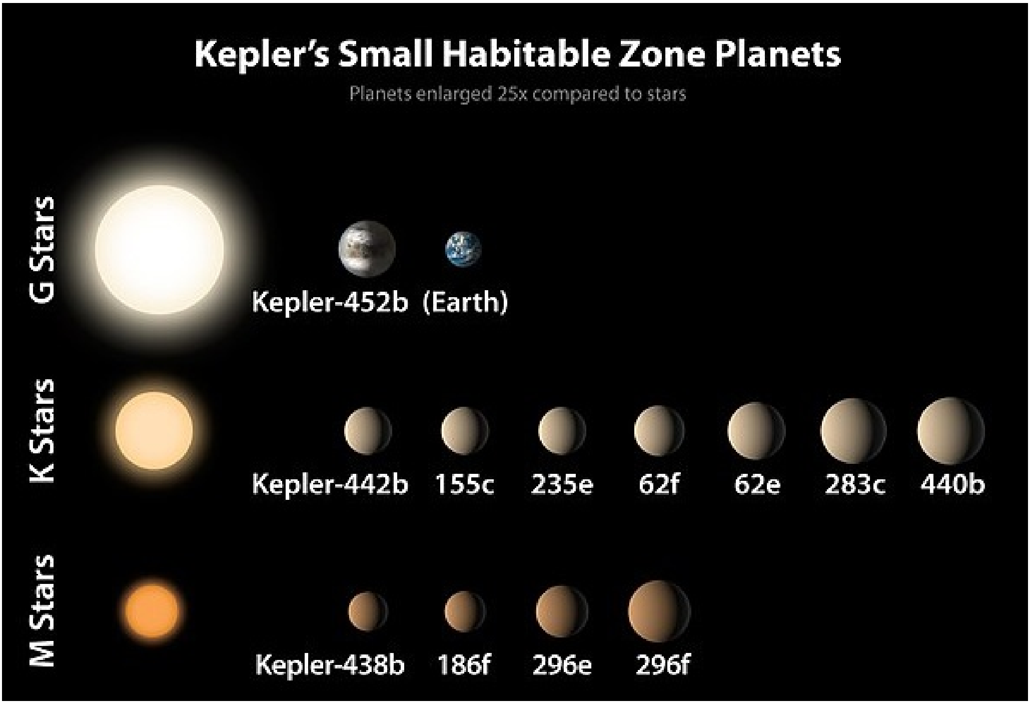
The transit method also allows for studies of the exoplanet's atmosphere, by study of the stellar spectrum of the host star. As the stellar radiation passes through the atmosphere, the atmosphere's elements will display absorption lines in the spectrum.

Microlensing:
Gravitational lensing happens when a star's gravitational field behaves like a lens, magnifying the light of a more distance star. If the star in the foreground hosts a planet, this can affect the measurement of the lensing effect. Some exoplanets have been identified in this way.

Today, after a little over 20 years of searching, ground and space-based observations have found over 4,000 confirmed exoplanets in the small proportion of the Milky Way that has been studied. Unconfirmed planetary candidates take the number to more than 5,600. Many of the identified exoplanets are gas or ice giants, but there are also some rocky Earth-size planets.

Radial Velocity	**801**
Transit	**3157**
Direct Imaging	**50**
Microlensing	**89**
Astrometry	**1**
TOTAL	**4098**

Source - https://exoplanets.nasa.gov/alien-worlds/ways-to-find-a-planet/



Credit: http://photojournal.jpl.nasa.gov/jpeg/PIA19827.jpg

EXOMOONS

An exomoon or extrasolar moon is a natural satellite orbiting an exoplanet. Given our knowledge of the number of moons in our own Solar System, it is reasonable to assume that exomoons will exist in similar numbers in other stellar systems. They are difficult to detect and Kepler observed a number of candidates, but none of these have yet been confirmed. The barycentre of the planet-moon system will perform an orbit around the host star, and the planet will exhibit a small wobble as it orbits the star, giving rise to a transit timing variation that can be measured and used to reveal the existence of the exomoon.

EXOPLANET UPDATES

The search for exoplanets is a fast moving field of research, and new discoveries are still being made. Regular updates can be found on the NASA exoplanet website:

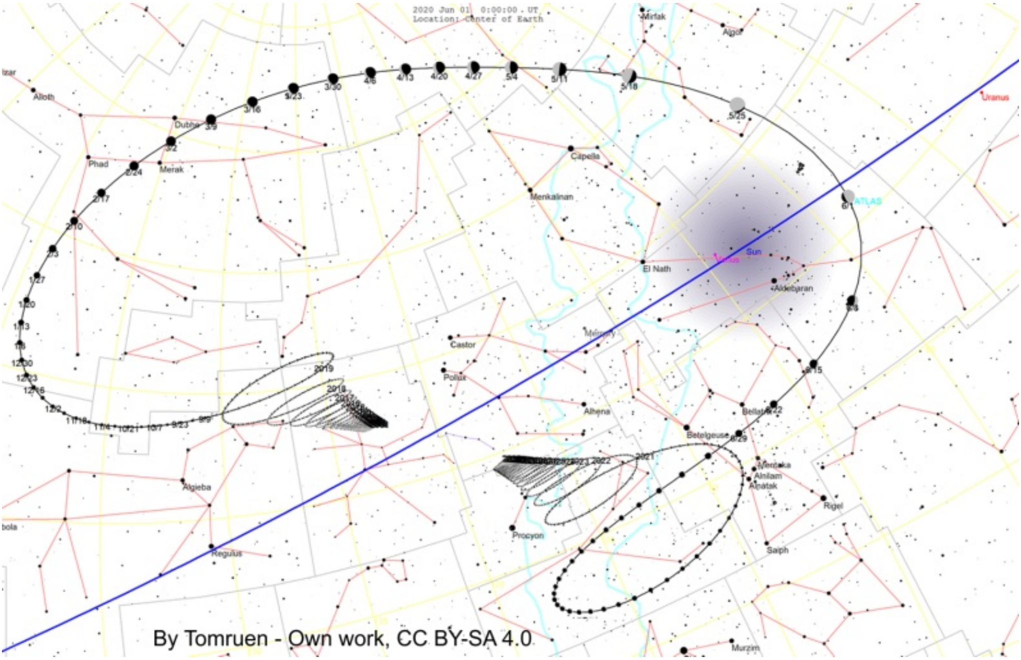
https://exoplanets.nasa.gov

Trevor Robinson
Trustee

Comet C/2019 Y4 ATLAS

Comet C/2019 Y4 ATLAS was discovered on December 28th 2019, by an automated telescope survey system known as ATLAS (the Asteroid Terrestrial impact Alert System), a 0.5m diameter telescope based on Mauna Kea in Hawaii. At discovery it was a 20th magnitude object found in the constellation of Ursa Major.
As is usual for newly discovered objects an alert was sent to the Minor planet Centre so that other astronomers could confirm the discovery and assist with tracking its trajectory through the solar system.
At that time the Comet was almost 3 AU away from the Sun, beyond the orbit of Mars. By 12 days later, a preliminary orbit had been calculated and circulated for verification.
This resulted in a confirmed orbit of 4,400 years and a perihelion – the closest approach distance to the Sun – of 0.25AU, inside the orbit of Mercury.
At the same time similarities were seen with the orbit of the Great Comet of 1844 [C/1844/Y1] and so it is now thought that this new Comet is quite literally a chip of the old Comet last seen in 1844.
Perihelion is due in May 2020 so between now and then the Comet is potentially going to get much brighter and more active.
Between early February and early March the Comet has brightened from magnitude 17 [Telescopes only] to magnitude 8 [Binocular object] and has started to develop a tail.
The Comet has also been found to be green in colour as a result of the presence of simple carbon based species such as Carbon Monoxide and C2+ - an ionised version of Acetylene.

Comet Atlas C/2019 Y4 on March 14th. Image by Martin Gembec @ CC BY-SA 4.0.



The tail is about 1 degree long [2 Lunar Diameters] – at the time of writing in late March but is likely [hopefully?] going to get more pronounced as perihelion draws closer.

If you want to in search of Comet C/2019 Y4 ATLAS then check out the star chart above.

Robert Williams

STOP PRESS: since this item was written the comet has fragmented into several pieces, which brought a sudden end to its march to become a naked eye comet. However, there has been a suggestion at the start of May that it is brightening again ...

KIELDER OBSERVATORY
Infinite Inspiration
™

NIGHT SKY

MAY 2020 (times in BST)

Lunar phases

Full moon	07/05/2020	11:45
Last quarter	14/05/2020	15:02
New moon	22/05/2020	18:38
First quarter	30/05/2020	04:29

PLANET SUMMARY

Mercury will be in the evening twilight. Venus will be an evening object close to its best apparition of the year. Mars is a challenging object in the morning twilight. Jupiter will be visible at around 0230 as will Saturn. Uranus is in conjunction with the Sun and not visible this month.

THE STARS AT 11PM

North – The two Bears and Draco are overhead. Cepheus and Cassiopeia are well placed. Perseus and Taurus are near the horizon.

East – Auriga is high up with Hercules well placed. Ophiuchus and Serpens Cauda is near the horizon.

South – Virgo and Leo are well placed.

West – Hydra is low down along with Gemini.

METEOR SHOWERS

The eta-Aquarid shower are active all month. The peak is on the 5th May but with a waxing gibbous Moon viewing this shower will be challenging.

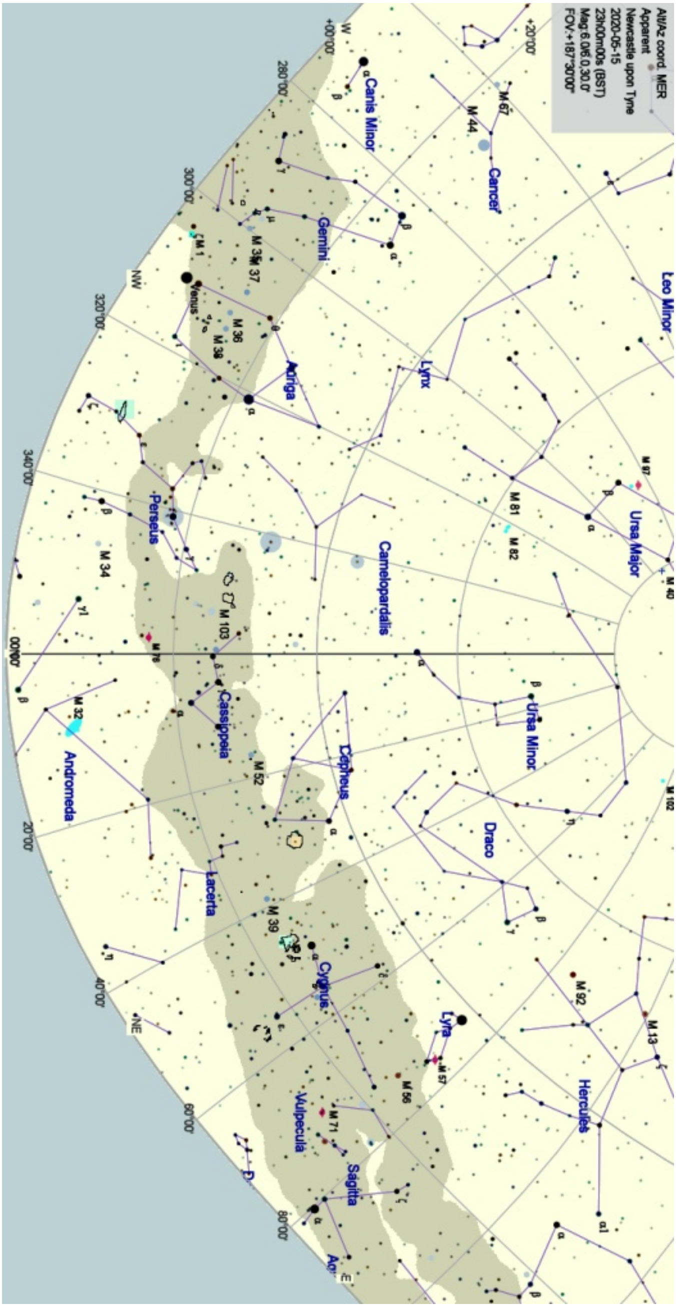
COMETS

Comet C/2019 Y4 ATLAS could be the spectacular comet of 2020, this month. With perihelion in May, and reaching maximum brightness towards the end of the month, In May it passes through the relatively dim constellation of Camelopardalis – the Giraffe – heading in the direction of Perseus. For more details consult the special article on this Comet. The Moon will be setting by 1am at this time. The Comet will be circumpolar – visible all night. Also visible, in binoculars or a small telescope, will be Comet C/2017 T2 PANSTARRS, which will be visible in Draco and Ursa Major – again circumpolar. Comet Swan has put on a good show in the Southern Hemisphere and may be visible in the North-East just before dawn in mid to late May.

The Planets 15/05/2020

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	04:58	03:22	05:17	05:13	03:01	01:37	01:49	04:29
Set	21:07	12:34	22:28	00:14	12:37	09:23	09:50	19:41

The view looking north from Newcastle at 11pm on 15/5/2020.



NIGHT SKY

JUNE 2020 (times in BST)

Lunar phases

Full moon	05/06/2020	20:12
Last quarter	13/06/2020	07:23
New moon	21/06/2020	07:41
First quarter	28/06/2020	09:15

PLANET SUMMARY

Mercury will be visible in challenging conditions after sunset. Venus is in conjunction with the Sun and not visible this month. Mars is a morning object visible in the morning twilight. Jupiter is also a morning object visible from around 0100 until 0300. Close by will be Saturn, the two will be close in the sky all month, within about 5 to 8 degrees of each-other. Uranus will be a challenging morning object about 15 degrees away from Venus.

THE STARS AT 11PM

North – The two Bears and Draco are overhead. Cepheus and Cassiopeia are well placed. Perseus and Taurus are near the horizon.

East – Hercules is high up with Lyra and Cygnus well placed.

South – Auriga and Hercules are high up.

West – Leo and Virgo are low down. Ursa Major and Bootes are well placed.

METEOR SHOWERS

There are no major meteor showers in June.

COMETS

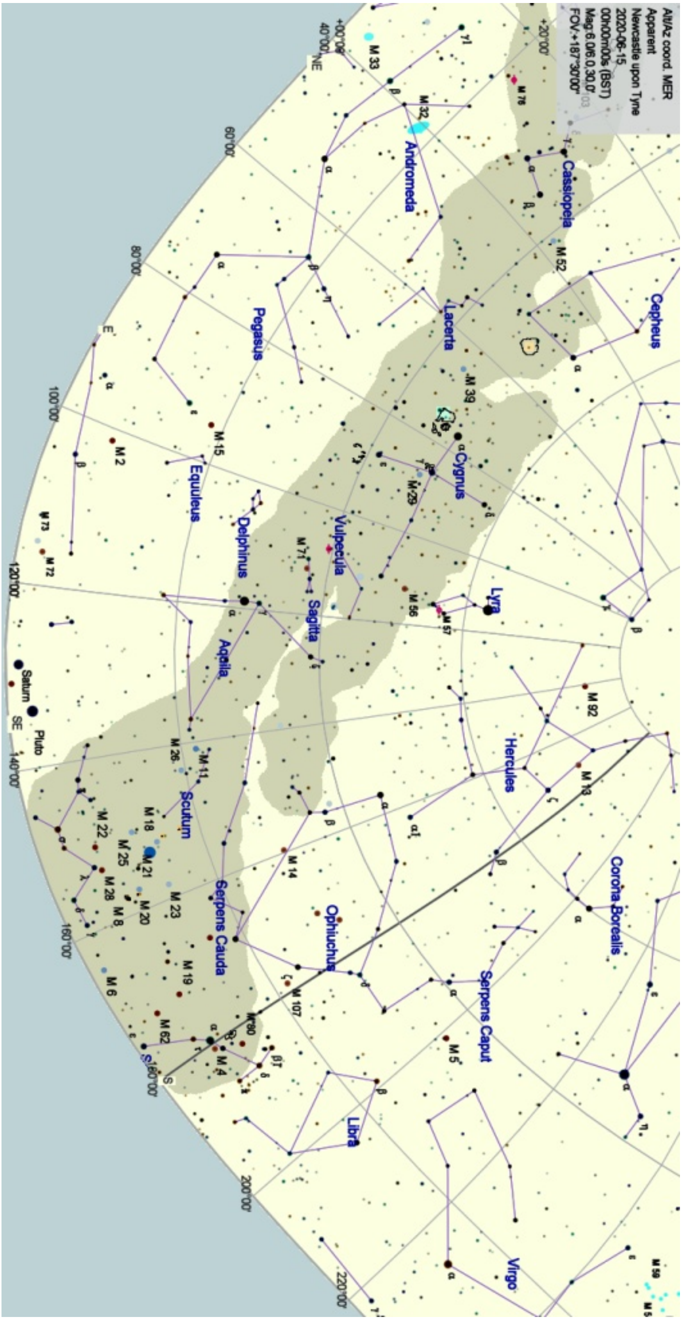
Comet C/2019 Y4 ATLAS will swing behind the Sun and hence not be visible in June. Comet Swan will still be around at the beginning of June, but at this time of year the sky never gets very dark, so observing it will be tricky.

The Planets 15/06/2020

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	04:27	02:26	06:05	03:47	01:34	23:28	23:41	02:30
Set	21:46	14:56	22:58	19:58	12:36	07:12	07:42	17:36

NIGHT SKY

The view looking south-east from Newcastle at midnight on 15/6/2020.



NIGHT SKY

JULY 2020 (times in BST)

Lunar phases

Full moon	05/07/2020	05:44
Last quarter	13/07/2020	00:28
New moon	20/07/2020	18:32
First quarter	27/07/2020	13:32

PLANET SUMMARY

Mercury is lost in the morning twilight. Venus will be barely visible before dawn. Mars is visible from around 0130 for about 2 hours before dawn. Jupiter is close to opposition and will be visible throughout the hours of darkness [approx. 2300 to 0300]. Saturn will be similarly placed and is still close to Jupiter. Uranus is a morning object visible from about 0200 until 0330.

THE STARS AT 11PM

North – Draco and the two Bears are well placed along with Cepheus. Cassiopeia and Perseus are low down.

East – Hercules is overhead. Lyra and Cygnus are well placed. Pegasus and Andromeda are low down.

South – Ophiuchus and Serpens [Cauda and Caput] are well placed. Sagittarius and Scorpius are on the horizon.

West – Auriga is well placed. Virgo is on the horizon.

METEOR SHOWERS

The minor shower – Southern delta-Aquarids are active all month. But with a low count due to the southerly position of the radiant.

Also visible are the alpha-Capricornids. With a maximum on the 30th July. A waxing gibbous Moon will make viewing this shower challenging. Fireballs are possible.

COMETS

There are no bright comets visible this month.

Night Sky credits:

Data sourced from Cybersky 5,

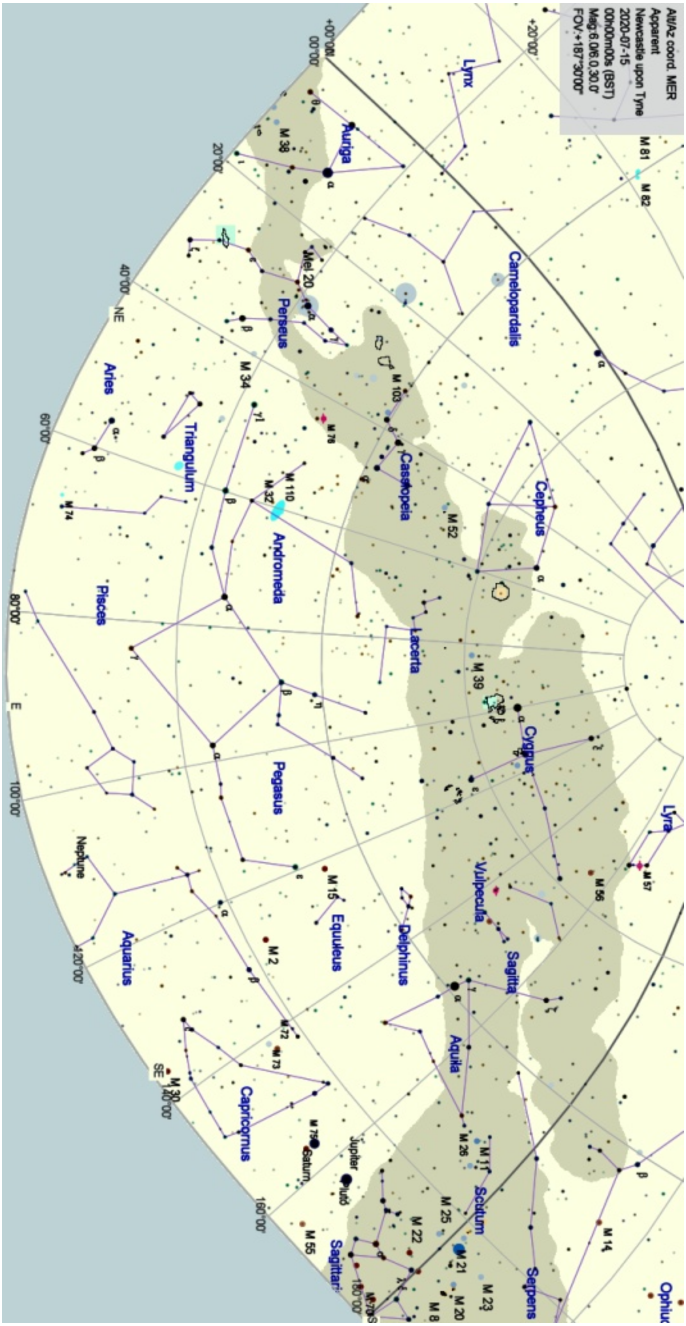
https://www.timeanddate.com/moon/phases/

and https://in-the-sky.org/ .

The Planets 15/07/2020

	Sun	Moon	Mercury	Venus	Mars	Jupiter	Saturn	Uranus
Rise	04:48	01:13	03:50	02:22	00:06	21:20	21:38	00:33
Set	21:36	16:10	20:02	18:09	12:21	04:54	05:33	15:34

The view looking east from Newcastle at midnight on 15/7/2020.



SCIENCE SLOT

Farewell to Spitzer

For more than 35 years the Hubble Space Telescope has been in the limelight as far as the public's perception of what professional astronomers are looking at in our Cosmos, from the vantage point of Earth orbit.

There is though another, no less venerable, space observatory that has been piling up the images and information but this time about the 'cool' Universe - Spitzer.

Hubble operates in the visible and near UV part of the spectrum, typically in the range 350nm [near UV/Blue] to 700nm [Red] segment of the Electromagnetic Spectrum. Here – as with our own eyes – we get essentially a more sensitive view of what we might see if our eyes were 2.6m in diameter and stationed above the interference of the Earth's atmosphere.

In this part of the spectrum we are seeing star processes that are fairly 'warm', in the range between 4,000K to 10,000K. Our Sun has a surface temperature of about 6,000K and many stars emit much of their radiation in this zone too. This is for fully formed stars.

However, dust clouds and star forming nebulae that are just about to begin their life towards becoming proper stars, radiate at cooler temperatures [typically of the order of 20 to 1000K] and as a consequence slightly longer wavelengths [typically 1000 to 10 microns (1nm to 0.01nm respectively)] in the Infra Red.

One key feature of all radiation is that it will only pass through nebulae etc., where the particle size of the dust grains are smaller than the radiation. Hence why many dust clouds are dusty because light cannot pass through or penetrate but IR radiation can pass though mostly unhindered. For the same reason, light will penetrate mist but won't pass through fog.

Over the past decades, scientists and engineers have come up with numerous ingenious ways to detect visible light using CCD and more recently CMOS-based sensors. Detecting the 'heat' signatures of cooler objects is a rather more challenging task, because until quite recently most detectors of this longer wavelength radiation were either poor resolution, poor sensitivity, very expensive, difficult to operate, lacking in fidelity or a combination of any of those five aspects.

However, over the past decade or so, a new type of detector for Infra Red radiation has become more readily available, based around

The Tarantula Nebula as seen by Spitzer. This star-forming region is part of the Large Magellanic Cloud, and so cannot be seen from the UK.

Credits: NASA/JPL-Caltech

Lead/Mercury-doped Silicon CCD chips. As with many technologies, instruments used in one branch of science find their way into other branches of science.

Another factor that is a major challenge for IR imaging devices is the thermal noise within the camera itself.

Visual imaging uses chips that are no cooler than a few 10's of degrees below room temperature – even on a chilly night in Kielder. DSLR cameras work fine at ambient night-time temperatures [around 260K to 270K] but work even better if cooled to around 250K [-20°C] , especially when imaging nebulae. Astro-imaging CCD cameras operate at typically -30°C to -50°C [or about 240K to 220K]. The aim is to minimise thermal noise from the CCD camera electronics that will show up when the images are electronically 'stretched' to bring out subtle details.

Because cameras used in infrared telescopes need to operate close if not below the actual temperature of the object they are imaging, they have to be cooled to liquid nitrogen [-196°C, 80K] or even liquid helium [-269°C, 4K] temperatures.

So, when the Spitzer Space Telescope was designed it had a camera chip encased in a cooling jacket and was

launched with the jacket already filled and chilled with solid helium. Spitzer was a follow-up to the IRAS mission launched 15 years before. IRAS had a detector with a chip format of 62 pixels on a rectangular grid. Spitzer's detector had 65000 imaging elements, some 1,000 times more definition than IRAS and operated in the range 3 to 180 microns.
On top of that, Spitzer also benefited from having lightweight optics, made of beryllium – the same metal being used for the James Webb Telescope mirror. Being metal the three elements of the optics cooled and equilibrated very quickly. It was also very light and as it was mostly one single metal composition it was very rigid and maintained the optical path very precisely. The optics had a spatial resolution of 1.5 arc seconds at 6.5 micron wavelength.

Spitzer's primary mission was to look at the births, the lives and the deaths of stars and nebulae. Once its store of cryogenic coolant ran out it went onto a legacy mission to investigate the nature of the distant universe; and once the detectors had warmed up it began another mission to investigate exoplanets. Like Hubble, it accumulated a vast repository of images and knowledge gained from the study of those images.

For more information about the Spitzer Space Telescope mission check out this website.... http://www.spitzer.caltech.edu/

Will there be a follow up to Spitzer? Hopefully yes, but it has a big act to follow.

Robert Williams

The Spitzer view of NGC6334, the Cat's Paw Nebula, in the constellation of Scorpius. This star-forming region lies in our own Milky Way galaxy.

Credit: NASA/JPL-Caltech

GALLERY

We would love to display your images here, whether they are taken up at Kielder or not - please send them to

newsletter@kielderobservatory.org

along with a brief description of how and when they were taken.

This is a mosaic of the moon taken on the 4th March this year through the observatory's 16" Meade telescope. It is composed of 26 separate images stitched together.

GALLERY

Shortly before lockdown we had some excellent clear skies ...

Venus is well placed at the moment. This was taken through the eyepiece of a 12" telescope with a simple digital camera on April 19th.

Photo: Nigel Metcalfe

February seems a long time ago, but up at the observatory we were battling with the effects of storm Ciara.

GALLERY

We may be all in lockdown, but there are still beautiful skies above the observatory!

Messier 13 a globular star cluster in Hercules. The cluster is 22,000 light years away and contains 300,000 stars all crammed into a sphere only 145 light years wide. You can spot this cluster with dark clear skies and a pair of binoculars or telescope. 10 x 5 minutes exposures with calibration.

Messier 81 and Messier 82 in Ursa Major: this photo was captured through a 5" SkyWatcher refracting telescope. This is the result of collecting an hour's worth of light from this pair of galaxies 12 million light years away.

Back to Venus! Two weeks after the shot on page 32 it is clear that the phase has changed, and the planet is displaying more of a crescent as it approaches the Sun. This photo was taken with a webcam at the prime focus of a 12" Newtonian.

Photo: Nigel Metcalfe

Kielder Observatory - a beacon for dark skies

https://kielderobservatory.org

KIELDER OBSERVATORY
Infinite Inspiration