NWASNEWS

Volume26 Issue 1

September 2020

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies

Welcome to the New Season

With the pandemic refusing to go away the committee having been discussing our options going forward as safely as it is possible, and this means our hall meetings will be postponed until at least January 2021, and even then we must be prepared to move to alternative on line meetings until we feel it suitable to move back to normal. This also applies to outreach and observing sessions.

Some other items that will need consensus from the members:

Our AGM will be on hold, because live questions will be difficult to do if the committee member is not available on Zoom.

I will stay on in position of chair while the situation continues, again very difficult to hand over without breaking social distancing in this period, and it will aid continuity.

FEES. We do not collect money for Zoom meetings, but we do have background costs that will need to be covered by an annual fee, and we have been looking at ways to collect these full in the knowledge that our bank, Lloyds, are very slow to change anything. Simon has looked at ways of collecting on line within our website, and Bob Johnstone will accept cheques so we need to finalise details and we will be in touch. Meanwhile be free to join us on our web site and at Zoom session that will be advertised.

We will continue with Zoom meetings rather than hall meetings. See below for the September Zoom Meeting ID and Password.

Andy Burns is inviting you to a scheduled Zoom meeting.

Topic: Wiltshire AS September Meeting

Time: Sep 1, 2020 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/88178237251?pwd=ckYzUDhNRjA0SnRUTUNZRVVqclZQZz09

Meeting ID: 881 7823 7251

Passcode: 011090

Keep good health...

Clear skies Andy Burns.

The summer comet.

Neowise F8 2020

This was taken after a session taking the comet in the evening of 20th July at the All Cannings Longbarrow. I was walking back to the VW and there was the comet, perfectly framed over the By way . Quickly swapped to a 300mm lens on tripod.

Andy

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

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

Meetings 2020/2021.

During COVID19 ZOOM meetingd

HALL VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

SEASON 2020/21

1 Sep	Nick Howes/How do you solve a problem like debris-Ahh?
6 Oct	Martin Griffiths/The Big Bang, Evidence & Estiblishment
3 Nov	Andrew Lound/A Jupiter Odyssey
1 Dec	Dr Lilian Hobbs/Eisa Eisinga: The Planetarium in the Bedroom.
2021	
5 Jan	Open Forum/Beginner meeting.
2 Feb	Prof David Southwood/Moon and Mars the next Giant Leap.
2 Mar	Pete Williamson/The moon & Moons of the Solar System.
6 Apr	Prof Mike Edmunds/The Clockwork universe.
4 May	TBC
1 Jun	Robert Harvey/Understanding the Universe.

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

Nick Howes

We are all finding problems with the space being filled with constellations of thousands of satellites being launched into Low Earth Orbit.

Now what about all the broken pieces, redundant satellites and even secondary launch debris?

And how do you launch new missions through this mess?

Nick Howes, our technical committee member is now engaged with the British programme of space launches had has a first hand perspective on the problem.

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns Chair, anglesburns@hotmail.com

Andy Burns Outreach and newsletter editor.

Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)

Philip Proven (Hall coordinator) Dave Buckle (Teas)

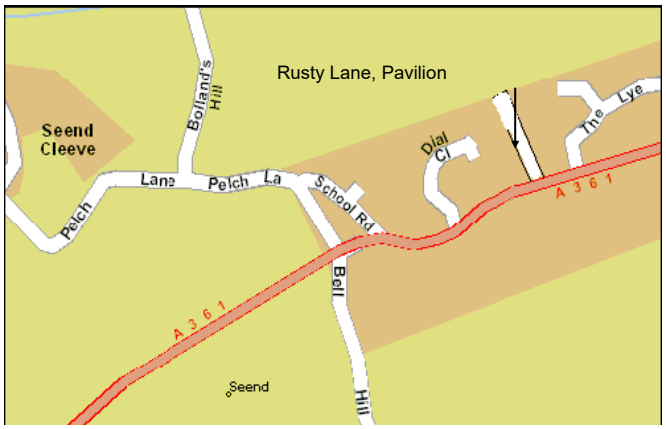
Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

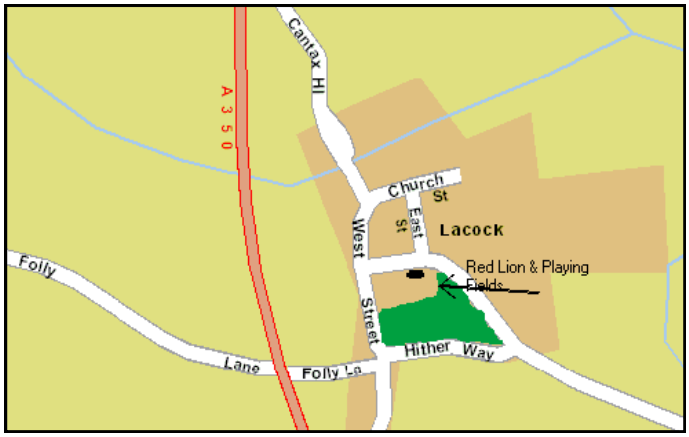
Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



Observing Sessions see back page



Swindon Stargazers

Swindon's own astronomy group

Meetings cancelled

Due to the current crisis our meetings, like many others have been cancelled at least until after the summer break. We hope to reconvene again in September when the postponed AGM will be held.

Ad-hoc viewing sessions postponed

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

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

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

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

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

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

For insurance reasons you need to be a club member to take part.

If you think you might be interested email the organiser Robin Wilkey (see below). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.

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

Enjoy astronomy at it's best!

Meetings at Liddington Village Hall, Church Road, Liddington, SN4 0HB – 7.30pm onwards

The hall has easy access from Junction 15 of the M4, a map and directions can be found on our website at:

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

Meeting Dates for 2020

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

Friday 18 September

Programme: AGM if restrictions lifted.

Friday 16 October

Programme: Dr James Fradgley MSc, FRAS: The Universe - 'A brief overview of what we know, or think we know'

Friday 20 November

Programme: Dave Eagle FRAS PGCE BSc (Hons): 'Comets, Enigmatic and Beautiful Visitors'

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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Address: 61 Northern Road
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BECKINGTON ASTRONOMICAL SOCIETY

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

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

Our Committee for 2016/2017 is

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

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

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

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

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm

Date	Title	Speaker
19th June	To Be Informed	

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

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

STAR QUEST ASTRONOMY CLUB

BATH ASTRONOMERS

The Bath astronomers meet regularly on line.
Please check out.

SPACE NEWS FOR SEPTEMBER 2020

Long retired Satellite falls to Earth

© *Provided by Space* *NASA's Orbiting Geophysical Observatory 1, or OGO-1, is seen in orbit on Aug. 25, 2020.* ***The satellite launched in September 1964 and fell to Earth on Aug. 29, 2020.***

A long-retired NASA satellite burned up in Earth's atmosphere over the weekend, the agency has confirmed.

NASA launched the satellite, called Orbiting Geophysics Observatory 1, or OGO-1, in September 1964, the first in a series of five missions to help scientists understand the magnetic environment around Earth. OGO-1 was the first to launch but the last to fall out of orbit; the satellite had circled Earth aimlessly since its retirement in 1971.

But orbiting Earth is a tricky thing to do, since the particles in our plush atmosphere collide with spacecraft and slow them down, even at very high altitudes where the atmosphere is thin. That speed reduction also lowers the spacecraft's altitude, until reentry becomes inevitable.

Related: The biggest spacecraft ever to fall uncontrolled from space

The 1,070-lb. (487 kilograms) OGO-1 experienced that inevitability on Saturday (Aug. 29), as NASA had predicted. The satellite re-entered at 4:44 p.m. EDT (2044 GMT) over the southern Pacific Ocean and burned up in the atmosphere, posing no threat to humans, NASA spokesperson Josh Handal told Space.com in an email.

The spacecraft hit the atmosphere about 25 minutes earlier than NASA had forecast, Handal said, resulting in a reentry location east of the agency's predictions. OGO-1 re-entered about 100 miles (160 kilometers) southeast of Tahiti, he added; in addition to tracking the satellite, NASA received reports of the event from people on the island.

OGO launches continued through 1969, when OGO-5 began orbiting Earth, but all OGO-1's successors had already re-entered Earth's atmosphere.

Astronomers find 100 brown dwarfs in our neighbourhood

Brown dwarfs are smallish objects sitting somewhere between stars and planets, making them notoriously hard to find. But a recent citizen science project aimed at finding the elusive Planet 9 has instead revealed a treasure trove of these oddities, right next door.

Brown dwarfs are weird. They're too small to ignite nuclear fusion of hydrogen in their cores, so they can't be stars. But they're much bigger than planets and form more like stars do. Indeed, they're big enough to (temporarily) fuse deuterium in their cores right after they're born.

Since they represent such an important bridge between planets and stars – a cosmic "missing link", if you will – astronomers are very curious about where they are, what masses they have, and how many exist in the universe.

Too bad they're really hard to find. They're small (less than a tenth the mass of the sun) and don't generate heat on their own. Instead the only way they emit light is through the release of heat from their formation, making them incredibly, inscrutably dim. Needless to say, astronomers don't know a lot about brown dwarfs.

The good news is that a citizen science project accidentally captured over a hundred of them in the solar neighbourhood. The project, Backyard Worlds: Planet 9, is intended to enlist amateur astronomical sleuths in the hunt for the hypothetical ninth planet in the outer edges of the solar system.

The citizen scientists haven't found that planet, but that

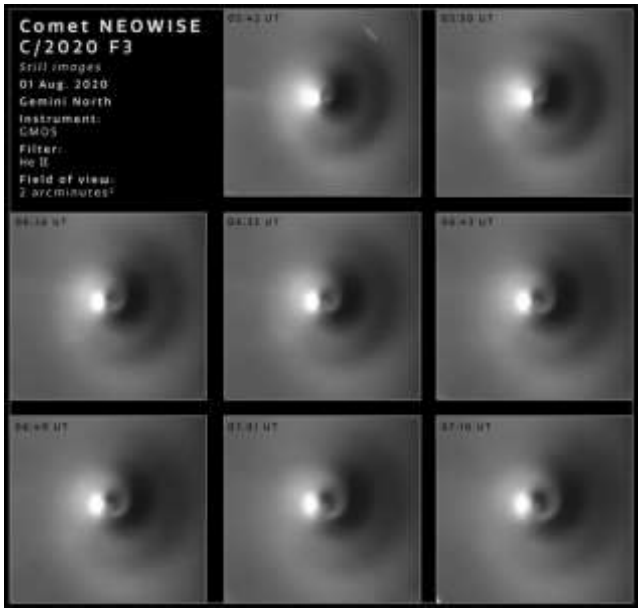
doesn't mean their work has been fruitless. After identifying the candidate brown dwarfs, follow-up observations with the W. M. Keck Observatory on Maunakea in Hawaii, NASA's Spitzer Space Telescope, Mont Megantic Observatory, and Las Campanas Observatory studied them in more detail.

Those follow-ups revealed that some of the brown dwarfs are among the coolest known (explaining why we haven't spotted them before). Some of them even have temperatures comparable to our own planet, despite being thousands of times more massive.

Comet NEOWISE Was Spiralling and Spinning as it Passed by Earth

Earlier this week, we shared an image of Comet NEOWISE (C/2020 F3) taken by the Hubble Space Telescope. And now, here are a group of images from the 8.1-metre Gemini North telescope in Hawaii. Like Hubble, Gemini North focused in on the comet's nucleus and coma, instead of its stunning, gossamer tails. But Gemini zoomed in and caught something Hubble didn't: Comet NEOWISE was rotating, which created a spiralling stream of molecular gas.

The close-up observations, led by Michal Drahus and Piotr Guzik of Jagiellonian University in Krakow, who were looking to try and see and study the rotational dynamics of the comet. Despite limitations imposed by the comet's proximity to the Sun, the researchers were able to confirm a 7.5-hour rotation period by measuring the spiral outflow of molecular gas as NEOWISE spun about.



The rotation of Comet NEOWISE is revealed in eight images captured over one-and-a-half hours on 1 August by the Gemini North telescope using the Gemini Multi-Object Spectrograph. In the compressed time-lapse sequence below, the images are looped nine times. Image: International Gemini Observatory/NOIRLab/NSF/AURA/M. Drahus/P. Guzik

Here's a timelapse video created by all the images taken by the team at Gemini North:

The prevailing notion is that most comets "release gasses in geyser-like jets and that is what researchers think is happening in the Gemini images," the National Science Foundation's NOIRLab said in a description. NOIRLab is US national center for ground-based, nighttime optical and infrared astronomy. "As the vaporized material erupts from the comet its rotation causes it to appear to spiral outward, much like the water from a spinning garden hose. The very same material impacts the comet's rotation causing its nucleus to spin -up or spin-down, though for most comets, the effect is too weak to detect."

In another set of impressive ground-based observations, an amateur astrophotographer from Germany, Bernd Gährken, was also able to capture some of the rotation as well.

Spiral rotation of Comet NEOWISE (C/2020 F3) as seen on July 26, with a with an 80cm f/10 Cassegrain at the Bavarian Public Observatory in Munich, Germany. On the right,Gährken has highlighted the spirals in the comet's rotation. Credit and copyright: Bernd Gährken.

Gährken was able to see the details of the spiral rotation, and he created a gif animation:

Astronomers will certainly be studying Comet NEOWISE's fascinating pass by our planet for quite some time!

Did a supernova cause the Devonian mass extinction event?

359 million years ago the Earth suffered one of its worst extinction events, and a team of researchers at the University of Illinois think that it might be caused by a series of supernova explosions no more than 35 light years away.

Every once in a while something disastrous happens to life on Earth. The biggest episodes we call extinction events. The latest big one happened about 65 million years ago, and was a very rough time for dinosaurs but turned out pretty awesome for the mammals. But that extinction event was just the latest in a long series of interruptions in the multitude of life on the planet. One of the earliest extinction events happened at the boundary of the Devonian and Carboniferous periods about 359 million years ago.

We're not exactly sure what triggered that extinction event. There's no clear smoking gun like there is for the asteroid impact evidence of the one that killed most of the dinosaurs. But a team of researchers from the University of Illinois are proposing a radical and otherworldly explanation: supernovae.

An artist's impression of Betelgeuse. Its surface is covered by large star spots, which reduce its brightness. During their pulsations, such stars regularly release gas into their surroundings, which condenses into dust. Image Credit: MPIA graphics department

The key piece of evidence leading to this hypothesis is the fact that fossils of plants remaining from that tumultuous era show signs of nasty sunburns: excess UV exposure. The ozone layer of the Earth does a fantastic job of blocking almost all the UV radiation from the sun, so the fact that these critters were getting an extra dose means that our ozone layer had to be depleted. There are a lot of potential geological processes that can scrub away our ozone layer, and there's also one celestial one.

The intense radiation from a close enough supernova blast can strip away our ozone, leaving the surface of the Earth

exposed to the UV onslaught from the sun. In general, intense UV radiation isn't too great for living beings, hence an extinction event.

The researchers estimated that a single supernova blast within 65 light years could have been enough to suppress our ozone layer for about 100,000 years. The fossil record indicates that life was having a tough go at it for three times that length, however, so the researchers speculate that the supernova wasn't alone. This isn't a crazy idea, as stars do tend to cluster and big stars do tend to go off as supernova relatively close by.

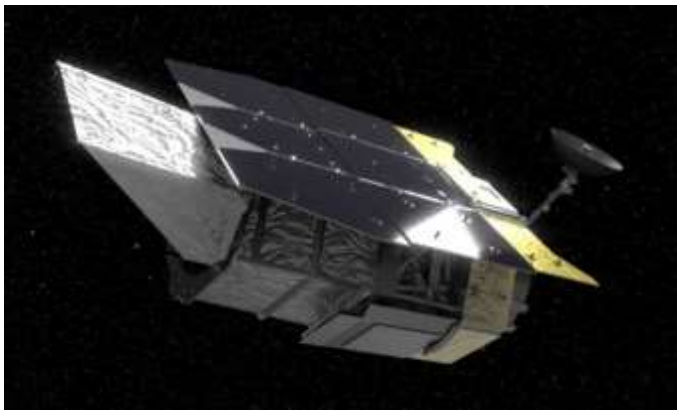
But as of yet this is an untested hypothesis. The next step is to find evidence in those fossil layers of an excess of certain radioactive elements like plutonium-244. This element isn't naturally produced on the Earth, and so the only way for it to exist in that layer of sediment is for it to have been put there as the shock-wave of the supernova washed over our planet.

If you're worried about the next supernova blast, don't stress out. The nearest supernova candidate to the Earth is the star Betelgeuse, which is located a safe 600 light years away.

There Could Be More Rogue Planets Than Stars in the Milky Way. Here's How Nancy Grace Will Find Them

Rogue planets are notoriously hard to detect, unless you're the Jedi in an Extended Universe novel. So far we have only been able to discover a handful, but estimates range from a few billion to a trillion solitary planets floating through the galaxy. NASA hopes to dramatically increase the number we've detected, and thereby better our estimates of how many there actually are, with the launch of the Nancy Grace Roman Space Telescope (formerly called the Wide Field Infrared Survey Telescope, or WFIRST).

The telescope is named after the "Mother of Hubble" and first female NASA executive, rather than the outspoken TV personality. Following in Dr. Roman's footsteps, the new infrared telescope hopes to catalogue as many rogue planets as it possibly can. It will do so by using a technique that has been extremely difficult up until now. According to a new paper published by researchers at Ohio State, it will be able to use this technique to detect up to 250 new rogue planets, with masses down to the size of Mars. It should be able to provide estimates of rogue planet counts that are 10 times better than our current estimates.



Rendering of the Nancy Grace Roman Space Telescope – Credit: NASA

The technique itself is called microlensing, and has been used to find novel exoplanets since 2004. In this technique, astronomers use a fun feature of relativity. Mass warps the fabric of space-time, and observatories can detect that warping. While normally thought of in terms of massive objects like black holes or galaxies, an individual planet actually has enough mass to cause a detectable amount of space-time warp.

The Roman telescope, which operates in the infrared, won't be able to detect the planets causing this warping directly as heat they emit will likely be too low for even it's ultrasensitive sensors to pick up. However, it will be able to detect any that happen to pass in front of a star.

NASA rendering of how astronomers can use microlensing to detect rogue planets. Credit: NASA

Similarly to how exoplanets are found by watching for a slight dip in their star's brightness as they pass in front of it, astronomers can watch for warping of the star's light as a rogue planet passes in front of it. These passes might be as short as a few hours, or as long as a few days, and will only happen once, unlike traditional planets whose orbit will take them in front of their star repeatedly. But the Roman Space Telescope should be able to detect these rapid transits even with fleeting glimpses of them.

There are still a lot of questions about rogue planets and planetary formation that even those brief transits should be able to tell us. The best theory we currently have of rogue planet formation is that they are forced out of their solar orbits by extremely large impacts early in their formative years. If astronomers can understand the effect those collisions have on early planetary formation they should be able to better understand how the evolution of early solar systems, and how likely that process is to form these types of planets.

Animation of a rogue planet showing how isolated they can be.
Credit: NASA/JPL-Caltech/R. Hurt

Luckily, the Roman Space Telescope has a major advantage over other observatories that have attempted to collect this microlensing data in the past – it will be based in space. Ground-based efforts, such as the Microlensing Observations in Astrophysics project, are plagued by atmospheric disturbances which make it hard to separate the signal from the noise. Hopefully with that added advantage, it will live up to its namesake's observational record when it launches in 2025.

Learn More:
NASA – Unveiling Rogue Planets With NASA's Roman Space Telescope.
NASA – Gravitational Microlensing
UT – How Do Planets Go Rogue?
UT – New Rogue Planet Found Closest to our Solar System
CNN – Invisible Rogue Planets Without Stars? NASA's New Space Telescope Could Find Hundred Of Them

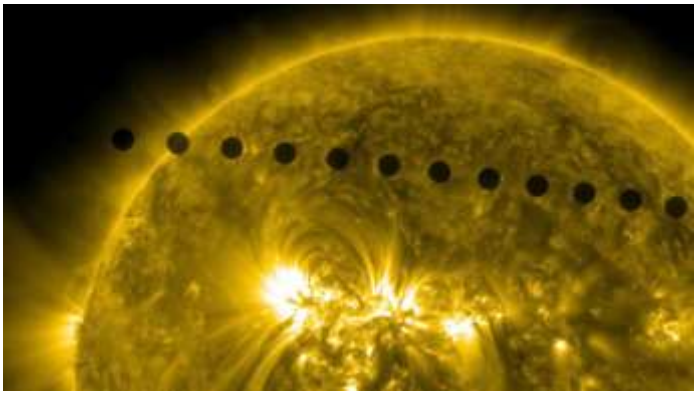
There's No Chemical Difference Between Stars With or Without Planets

Strange New Worlds

Imagine if a star could tell you it had planets. That would be really helpful because finding planets orbiting distant stars – exoplanets – is hard. We found Neptune, the most distant planet in our own solar system, in 1846. But we didn't have direct evidence of a planet around ANOTHER star until….1995.…149 years later. Think about that. Any science fiction you watched or read that was written before 1995 which depicted travel to exoplanets assumed that other planets even existed. *Star Trek: The Next Generation* aired its last season in 1994. We didn't even know if Vulcan was out there. (Now we do!…sortof)

Jupiter (right bright point) and Saturn (left bright point) seen here against the Milky Way were the most distant planets we could see before inventing telescopes – C. Matthew Cimone

Since 1995, with the advent of planet hunting telescopes like Kepler and TESS, we've found THOUSANDS of planets orbiting other stars. These missions find exoplanets literally by looking for their shadows. Sometimes an exoplanet's orbit crosses our view of a distant star blocking out some of the star's light. This "transit" of the planet creates a shadow in the observed light from the star which we can then use to determine the size of the planet, whether it's a rocky planet like Earth or a gas giant like Jupiter, and the length of the planet's year around its parent star.



Transit of Venus across our own Sun imaged at different stages of the transit. Planet hunting telescopes are looking for these events to discover exoplanets orbiting other stars. c NASA

But planets are very small compared to their host stars. The amount of light they block is a fraction of the star's overall light, so our equipment needs to be very sensitive. And if the planets are not orbiting in such a way that they cross our view of the star, say if we are looking at the distant solar system from the top down, we may have a harder time detecting their presence. So, scientists are looking for alternative means of discovering planets and one might be to study the parent stars themselves. Stars are big and bright and easy to spot. If stars that give birth to a solar system are somehow unique to stars that don't, we might have a powerful new way of planet hunting. Specifically, astronomers are paying close attention to a star's chemical composition – the right star stuff.

Building a Solar System

Planets and stars share the same stuff. Our solar system formed from one enormous rotating cloud of dust and gas called a protoplanetary disk. 99.8% of the stuff was concentrated in the centre drawn together by gravity to form the Sun.

An actual phot of of a protoplanetary disk of young star HL Tauri about 450 light years away imaged by the ALMA telescope C. ESO/ALMA

The remaining 0.2% of whatever didn't end up within the Sun itself flattens out to form the disk – imagine like how a ball of dough flattens into a pizza as it is spun. This flattening is why all the planets orbit the Sun along a similar plane called the Plane of the Ecliptic. Within the spinning disk, material begins to accrete forming planetesimals which become the seeds of future planets. But what is this stuff? It's important! It's what the planets and you and I are made of. Astronomers refer to it as "metals." In astronomy, "metals" are considered anything on the periodic table above atomic number 2 – so anything heavier than hydrogen and helium like the calcium in your bones or the iron in your blood. In fact, at the birth of the Universe, there was ONLY hydrogen, helium, and small amounts of lithium. None of the other elements existed. Those elements are themselves created by the stars, deep in their interior, as they convert hydrogen fuel through nuclear fusion into heavier and heaver elements – the metals. Once these stars explode at the end of their lives as supernova, they spill their guts into the interstellar void seeding it with the stuff that makes other stars as well as PLANETS. Likely the first generation of stars in the early universe had no planets at all. There wasn't yet the raw material to build them. We call those Population III stars.

The next generation of stars, Population II, were the first to form in a universe that was enriched with heavier elements. We're not entirely sure if this group of stars formed with enough metals to make planets. We want to pinpoint when exactly the first planets formed in the Universe to estimate how early life could have existed. But if planets did form around Population II stars, likely they were quite small and orbited very closely to their parent stars – far closer than

Mercury does in our own solar system. Probably not ideal for life at a sweltering 1600K surface temperature. Even if life did form around these stars, it is likely extinct by now as these stars lived shorter lives than our Sun and have already burned out. (Unless of course that life left its solar system to explore the Universe and still exists somewhere as an ancient space-faring civilization from a long-dead star…one can imagine.)

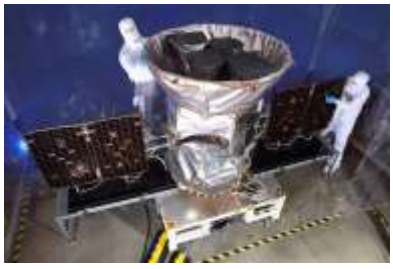
Which brings us to Population I, the group of stars our Sun belongs to. Our Sun formed in a Universe where billions of years of star births and deaths had already occurred. The Universe had been fertilized with more metals. Not only do the metals in a protoplanetary disk create the raw material for planet formation, but also protect the disk itself from being blown away by the parent star's radiation. More metals mean more time available for the planets to form before the star's energy eventually evaporates the remaining material that hasn't yet formed planets

Comets like NEOWISE, which recently visited our skies, is literally just some of the leftover stuff from the protoplanetary disk that formed the solar system c. Matthew Cimone

"Where to Look"

Understanding how planets form give us our first clue as to where to look for them – stars with metals. Remember, the host star and their planets form from the same cloud of stuff, so some of those metals are mixed into the star. By looking at the light from a star using spectroscopy, we can tell how highly enriched it is with metals – the star's "metallicity."

Studying these metal-rich stars, we know terrestrial rocky planets like Earth are 1.72 times more likely to form around them. Even gas giants are more likely to form around metal-rich stars. Although made from gases rather than metals, gas giants like Jupiter are theorized to form around an initial rocky seed or from the disruptions in the flows of hydrogen gas orbiting in the disk caused by the introduction of metals.



NASA's Transiting Exoplanet Survey Satellite being prepped for launch C NASA

But while a star's chemistry can tell us the *likelihood* that planets are there – can the chemistry tell us exoplanets ARE there!? Is there a key chemical fingerprint for a star to tell us in a booming stellar voice "Yes indeed, I host planets! Behold my children!"

The research so far SAAAYYYYYSS……no. I know. Kind of anticlimactic.

BUT there is still hope. Last week, the Monthly Notices of the Royal Astronomical Society posted a study by the National Centre of Competence in Research PlanetS. NCCR PlanetS researched 84 stars observed by the 10M Keck Telescope in Hawaii. The team of researchers were trying to determine if planet formation leaves a unique chemical tell on a star – a beacon for us to know that indeed the star had given rise to planets – but a unique indicator couldn't be found. Comparing 16 stars with planets and 68 without, the team found that planets orbit chemically diverse stars. But the findings are still useful. The team issued a warning that given the preponderance of planet discoveries, most of the stars in the study "probably have planets" (pg 8/3698 of the study) that just haven't been found yet. So, the study might not be entirely accurate. However, this research could yield future discoveries of what KIND of planets, in terms of size or composition, form around a star with a certain chemical signature especially if/when planets are discovered around more stars used in the study. So, while we may not be able to know IF planets exist because of a star's chemistry, in the future we may be able to infer with more accuracy what types of exoplanets orbit a star given a certain metallicity. For example, we know that metal-rich stars on average give rise to more planets – perhaps the types and quantities of each metal result in a certain arrangement of the solar system, or the quantities of terrestrial vs gas giants, or whether the planets are habitable. More research is needed.

In the meantime, we continue searching for planets using transits. TESS completed its primary mission, imaging 75% of the sky in a two-year survey, just this past August 20th. We don't yet know what discoveries will be found in the data including perhaps new ways to understand the relationships between a host star and its planets. Whatever we find will certainly inform both future planet hunting missions as well as provide inspiration to the fictional stories boldly going to the strange new worlds our research has discovered. Engage!

Further Reading:

NCCR PlanetS Report http://nccr-planets.ch/blog/2020/08/17/stars-with-planets-show-no-special-fingerprint

"Revealing a Universal Planet-Metallicity Correlation for Planets of Different Sizes Around Solar-Type Star (Astronomical Journal) https://iopscience.iop.org/article/10.1088/0004-6256/149/1/14

Everyone Took Pictures of Comet NEOWISE, Including Hubble

This summer we were (finally) treated to a spectacular, naked-eye comet, C/2020 F3 NEOWISE. And while seeing it with our own eyes was a joy, it was incredible to see the varied photos of NEOWISE taken by people around the world, showing the comet's long gossamer tails, filled with detail and color. (See our gallery of images here.)

Now, the Hubble Space Telescope has released a high-resolution image of NEOWISE. However, it might not be the view you may have expected.

Instead of focusing on the comet's beautiful tails, Hubble zeroed in on coma, the shell of gas and dust that surrounds its nucleus, which expands and changes as it is heated by the Sun. NASA says this is the first time Hubble has photographed a comet of this brightness at such high resolution after this close of a pass to the Sun.

This image of comet C/2020 F3 (NEOWISE) was taken by the Hubble Space Telescope on Aug. 8, 2020. ***Credits: NASA, ESA, A. Pagan (STScI), and Q. Zhang (Caltech)***

"Hubble has far better resolution than we can get with any other telescope of this comet," said lead researcher Qicheng Zhang of Caltech in Pasadena, California. "That resolution is very key for seeing details very close to the nucleus. It lets us see changes in the dust right after it's stripped from that nucleus due to solar heat, sampling dust as close to the original properties of the comet as possible."

The image was taken by Hubble on August 8, 2020. The great part is that the nucleus appears to have stayed intact, even after its closest approach to the Sun, which was in early July, at a distance of 27 million miles (43 million kilometers). Comets have a tendency to break apart due to thermal and gravitational stresses at such close encounters.

The lead image shows a ground-based image of comet C/2020 F3 (NEOWISE) taken from the Northern Hemisphere on July 16, 2020 (taken by retired Hubble image processing team guru Zolt Levay), with an inset of the Hubble image.

Even before Hubble launched, Zolt Levay was instrumental in developing software to translate Hubble data into images for analysis. He refined techniques into an artform, of taking data from the various filters on Hubble and turning them into beautiful photos that not only were pleasing to the eye, but also told the science story of the objects in the images.

So, here's the science of this image: Even though the nucleus is to small to be seen, astronomers estimate it measures no more than 3 miles (4.8 kilometers) across. So, the Hubble image shows a portion of the comet's coma, the fuzzy glow, which measures about 11,000 miles (18,000 kilometers) across in this image.

Hubble scientists explained that the two structures appearing on the left and right sides of the comet's center are jets made up of ice sublimating from beneath the surface of the nucleus, with the resulting dust and gas being squeezed through at a high velocity. The jets emerge as cone-like structures, then are fanned out by the rotation of comet NEOWISE's nucleus.

This animation displays the rotation of comet C/2020 F3 (NEOWISE) shortly after its pass by the Sun. The two images were taken three hours apart on Aug. 8, 2020, by NASA's Hubble Space Telescope. Two jets emerging from the comet's nucleus are being fanned out by the comet's rotation. Credits: NASA, ESA, STScI, and Q. Zhang (Caltech)

So, while this photo may not be a "stunner" that we've become accustomed to with Hubble, the details in the image data will help reveal the color of the comet's dust and how those colors change as the comet moves away from the Sun. This, in turn, may explain how solar heat affects the composition and structure of that dust in the comet's coma. Scientists say the ultimate goal here would be to learn the original properties of the dust to learn more about the conditions of the early solar system in which it formed.

Comet NEOWISE is now speeding away towards the outer solar system, traveling at a whopping 144,000 miles per hour (over 230,000 km/h). It will not return to grace our skies again for nearly 7,000 years.

Farewell Comet NEOWISE, and we thank you.

First Laser Space Debris Detection Made… in Daylight

A new technique may prove to be a powerful tool in the battle to mitigate space debris.

As the Space Age continues into its seventh decade, space debris is now growing at an exponential rate. Most of this debris is in Low Earth Orbit (LEO), and ranges from bus-sized discarded rocket boosters and defunct satellites, to tiny millimeter-sized fragments.

Crowding in orbit: space debris visualization. Credit: ESA/CC BY-SA 3.0 IGO

Obviously, knowing the exact position and orbit of these fragments is essential to operations in LEO. The International Space Station, for example, must routinely perform debris avoidance maneuvers (DAMs) to avoid inbound debris, with the crew often sitting out the pass inside their Soyuz escape vehicles. The new era of communications constellations spearheaded by SpaceX's Starlink initiative will also add on to this burden in coming years.

The Challenge of Tracking Debris

One existing tracking technique is known as laser ranging, and allows for space agencies to precisely model the orbit of a given object by bouncing a laser beam off of it sent from a

ground-based station and measuring the return time. While effective, this technique traditionally suffers from a crucial drawback: it only works when satellites are visible.

This dilemma is familiar to amateur astronomers and satellite spotters. Go out under the twilight sky at dawn or dusk and watch for a few minutes, and you're likely to see a satellite (or more likely, a discarded rocket booster), looking like a wandering 'star' moving silently across the sky. These shine because of reflected sunlight, making them visible to automated tracking systems as well. The problem is, this visibility window is narrow, and limited to dawn and dusk. At local midnight, satellites are still up there in the darkness of the Earth's shadow. They're still present in the daytime as well, illuminated by the Sun but also swamped out in the Sun's glare against the blue sky.

Now, a recent study from The Institute for Space Research (IWF) in Graz, Austria, has demonstrated a new technique to acquire and track satellites… in the daytime. The IWF recently tested the method using telescopes at the Graz Lustbühel laser station working in concert with study co-authors Tim Flohrer and Beatriz Jilete at the European Space Agency's Space Debris Office based in Darmstadt, Germany. The technique uses a combination of light filters looking at a specific wavelength, which increases the contrast of the target object in orbit against the deep blue background sky.

Laser-ranging from the Graz Lustbühel laser station. Credit: A. Ocram/Wikimedia Commons

"For the visual observations of space debris, wavelengths above approximately 700 nanometers were used," Michael Steindorfer (Austrian Academy of Sciences) told *Universe Today*. The visual observations are necessary to pre-center the target due to inaccurate orbit predictions."

The study successfully tracked 40 objects in the daytime using this new technique. The method employed an 80 cm (31.5-inch) aperture telescope, and was also able to capture daytime stars 10 times fainter than are visible to the naked eye at night, down to an amazing +8th magnitude.

"We expect that these results will significantly increase debris observation times in the near future," says Steindorfer in a recent press release. Ultimately, it means we will get to know the debris population better, allowing us to better protect Europe's space infrastructure."

Laser ranging for satellite tracking has only become available to researchers in the past few years, and the new method for daytime tracking with enable researchers to greatly extend this capability. Now, the next step is to test the capability at the ESA's Optical Ground tracking Station based in the Canary Islands off the coast of Morocco.

ESA's satellite tracking Optical Ground Station (OGS) in the Canary Islands. ESA/Austrian Academy of Sciences

One wonders if this could potentially open up a new realm of 'daytime astronomy,' and if this technology could trickle down to the amateur sector.

"In principle, this technique could be used to detect any point-like objects of a certain brightness," Steindorfer told *Universe Today*. "However, you will be limited in terms of the pointing accuracy of your telescope mount model."

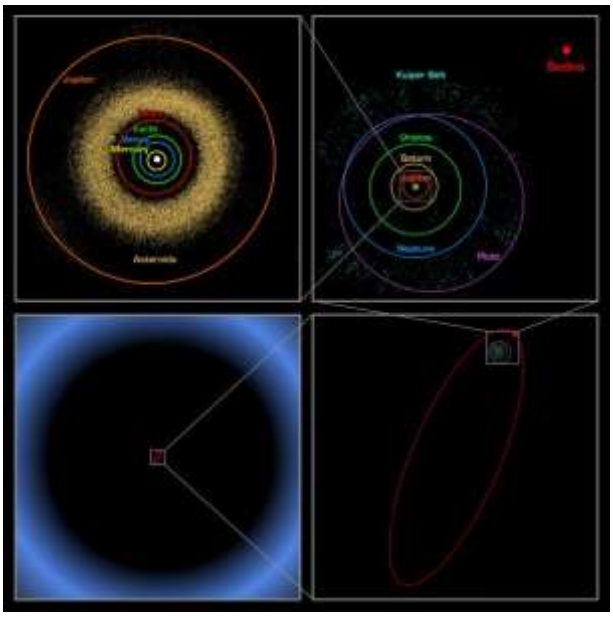
Space debris may be a mounting concern, but this new method will extend our ability to chronicle the situation… and perhaps soon, astronomy and satellite-tracking won't end at sunrise.

The Sun Might Have Once Had a Binary Companion Star

For some time now, astronomers have known that the majority of systems in our galaxy consist of binary pairs rather than individual stars. What's more, in recent decades, research has revealed that stars like our Sun are actually born in clusters within solar nebulas. This has led to efforts in recent years to locate G-type (yellow dwarf) stars in our galaxy that could be the Sun's long-lost "solar siblings."

And now, a new study by Harvard astronomers Amir Siraj and Prof. Abraham Loeb has shown that the Sun may once have once had a very similar binary companion that got kicked out of our Solar System. If confirmed, the implications of this could be groundbreaking, especially where theories on how the Oort Cloud formed and whether or not our system captured a massive object (Planet Nine) in the past.

Their study, titled "The Case for an Early Solar Binary Companion," recently appeared in *The Astrophysical Journal Letters*. For the sake of this study, Siraj and Loeb considered the formation of the Oort Cloud, which remains a mystery to astronomers. The reason for this is because of the ongoing problem of how the Oort Cloud and scattered disc objects (SDOs) beyond the orbit of Neptune achieved their current ratio.



Zooming out; the inner solar system (upper left), the outer solar system (upper right), the orbit of Sedna (lower right) and the inner edge of the Oort cloud (lower left). Image credit: NASA

Previously, astronomers held that the Oort Cloud formed from debris left over from the formation of the Solar System and its neighbors. In other words, they believed the objects that populated this region were scattered by the planets to great distances, and some were even exchanged between stars. As Siraj explained in a recent CfA release, a binary model of the Solar System could provide the missing piece of the puzzle:

"Previous models have had difficulty producing the expected ratio between scattered disk objects and outer Oort cloud objects. The binary capture model offers significant improvement and refinement, which is seemingly obvious in retrospect: most Sun-like stars are born with binary companions."

In the past, astronomers have held that the Oort Cloud formed in the birth cluster where the Sun was born, as a result of the drag produced by dense cluster gas. Unfortunately, in this scenario, this same drag hinders the scattering of comets in the Trans-Neptunian regions to large distances, something that is inconsistent with what we see with Trans Neptunian Objects (TNOs) today.

"Binary systems are far more efficient at capturing objects than are single stars," added Loeb. "If the Oort cloud formed as observed, it would imply that the Sun did in fact have a companion of similar mass that was lost before the Sun left its birth cluster."

Of course, if the Sun did indeed form with a binary companion, this naturally raises the question of where this companion is today. To this, Siraj and Loeb hypothesize that the gravitational influence of passing stars in the birth cluster could have whisked it away. This is consistent with previous research conducted by astronomers from the CfA, which suggested that our Sun lost a Sun-like companion billions of years ago.

In fact, in 2018, astronomers announced that they had located one of the Sun's sibling after observing an exact twin roughly 184 light-years from Earth. "Before the loss of the binary, however, the solar system already would have captured its outer envelope of objects, namely the Oort cloud and the Planet Nine population," said Siraj. "The Sun's long-lost companion could now be anywhere in the Milky Way."

What's more, this study could have implications for the existence of Planet Nine (aka. Planet X), a Neptune-sized planet that is hypothesized to have a highly elongated orbit that places it far beyond Pluto. Astronomers have theorized that this planet exists based on the fact that certain families of smaller objects in the Kuiper Belt have unique orbits that suggest the presence of another body in the area.

In more recent years, some astronomers have suggested that Planet Nine might actually be a primordial black hole located at the edge of our Solar System. It has further been suggested that the presence of this black hole could be discerned by watching for flares that would be produced whenever it consumes a comet. Of course, future missions will be needed to determine the true nature of Planet Nine (if it does in fact exist).

Artist's impression of Planet Nine as an ice giant eclipsing the central Milky Way, with a star-like Sun in the distance. Credit: Tom Ruen/Wikipedia Commons/ESO

In any case, the results of Siraj and Loeb's study bolster the case for Planet Nine being a captured body, another theory that is being batted around. As Loeb explained, their results also suggest that it has companions in the outer Solar System:

"The puzzle is not only regarding the Oort clouds, but also extreme trans-Neptunian objects, like the potential Planet Nine. It is unclear where they came from, and our new model predicts that there should be more objects with a similar orbital orientation to Planet Nine."

The implications of this research go beyond the formation of the Solar System, however, and even offers new insight into how life emerged here on Earth."Objects in the outer Oort Cloud may have played important roles in Earth's history, such as possibly delivering water to Earth and causing the extinction of the dinosaurs," said Siraj. "Understanding their origins is important."

These and other theories concerning the Oort cloud and Planet Nine (and possible companions) demand that further observations be made of the outer Solar System. At the moment, this is very challenging for astronomers given their sheer distance from the Sun. However, this could begin to change early next year when the Vera C. Rubin Observatory – formerly known as the Large Synoptic Survey Telescope (LSST) – collects its first light.

Artist's impression of a Kuiper Belt Object in the outer Solar System. Credit: NASA, ESA, and G. Bacon (STScI)

Once operational, this observatory will conduct vast astronomical surveys of the southern sky and map the Universe to determine the influence of Dark Matter and Dark Energy and learn more about transient phenomena. In addition, the VRO will dedicate time to mapping small objects in the Solar Systems like Near-Earth Asteroids (NEAs) and Kuiper Belt Objects (KBOs), increasing the number of cataloged objects by

a factor of 10 to 100.
As he put it, Siraj is optimistic that the VRO will also shine a light on the possible existence of massive bodies in the outer Solar System:
"If the VRO verifies the existence of Planet Nine, and a captured origin, and also finds a population of similarly captured dwarf planets, then the binary model will be favored over the lone stellar history that has been long-assumed."
Further Reading: CfA, *The Astrophysical Journal Letters*

Remembering Don Arabian, the 'Mad Genius' Behind NASA's Apollo Engineering Team

One of the truly unsung heroes of the Apollo program has passed away at age 95. Donald D. Arabian, Chief of the Apollo Test Division, headed the Mission Evaluation Room (MER), which was responsible for solving in-flight problems during the Apollo missions to the Moon.
His nickname was "Mad Don," and anyone who had the privilege of meeting him or working with him described Arabian as "one of a kind," "colorful," and "completely and totally unforgettable." But in the book "Apollo: Race to the Moon" authors Charles Murray and Catherine Bly Cox designated Arabian as one of four people responsible for the success of the Apollo Program.

Some Astronomers Think Betelgeuse Dimmed Because it "Sneezed". And it Might be Getting Ready to do it Again

Betelgeuse, the tenth brightest star in the night sky and the second brightest in the constellation Orion, has been behaving a little oddly lately. Beginning in December of 2019, researchers from Villanova University noticed the red supergiant was dimming noticeably. This trend continued into the new year, with Betelgeuse dimming throughout January and February of 2020. eventually losing two-thirds of its brilliance.

From this point onward, Betelgeuse began to brighten again and returned to its typical visual brightness by April. And now, the massive star dimming once again, and ahead of schedule. In response, an international team of researchers recently conducted a study where they theorized that this pattern might be the result of Betelgeuse "sneezing" out dense clouds of hot gas which then cooled.

The study that describes their observations via The Astronomer's Telegram and their full results appeared in *The Astrophysical Journal*. The team was led by Andrea K. Dupree, the associate director of the Harvard-Smithsonian Center for Astrophysics (CfA), the National Solar Observatory, Villanova University, the Max Planck Institute for Astrophysics, the Leibniz Institute for Astrophysics Potsdam, and numerous universities and research institutes.

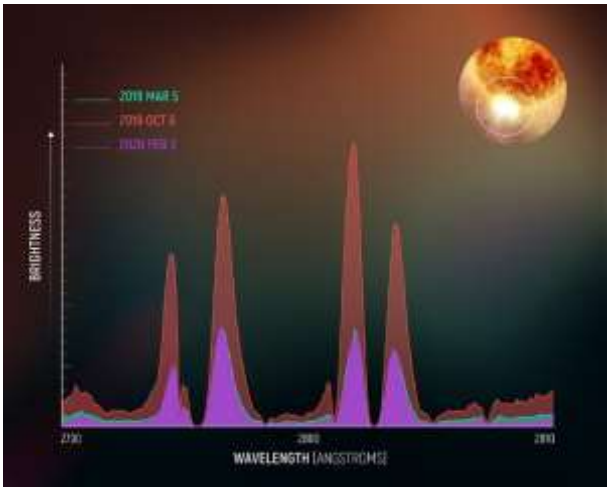
As a variable star, Betelgeuse has been known to go through periods of dimming and brightening that last about 420 days. However, the timing and extent to which the star was diminishing in brightness since 2019 seemed highly unusual. Explanations for why it was behaving this way included the possibility that Betelgeuse was about to go supernova, that it was creating clouds of dust, or because of massive stars spots.

To this, the team led by Dupree offers another explanation: the dimming was caused by the ejection of hot dense clouds of plasma that temporarily obscured our view of the star. This was based in part on observations conducted between October and November 2019 by the Hubble Space Telescope, just a month before ground-based observatories began to notice dimming in the star's southern hemisphere.
These observations noted hot material moving outward through the star's extended atmosphere at over 320,000 km (200,000 mi) per hour. From this point onward, Hubble observations conducted in the ultraviolet wavelength provided a timeline that researchers were able to follow backward, allowing them to pinpoint the exact moment when the dimming began. As Dupree explained in a recent CfA press statement:
"With Hubble, we had previously observed hot convection cells on the surface of Betelgeuse and in the fall of 2019 we discovered a large amount of dense hot gas moving outwards through Betelgeuse's extended atmosphere. We think this gas cooled down millions of miles outside the star to form the dust that blocked the southern part of the star imaged in January and February. The material was two to four times more luminous than the star's normal brightness. And then, about a month later the south part of Betelgeuse dimmed conspicuously as the star grew fainter. We think it possible that a dark cloud resulted from the outflow that Hubble detected. Only Hubble gives us this evidence that led up to the dimming."

Graphic showing how Betelgeuse could be dimming. Credit: NASA/ESA/and E. Wheatley (STScI)
Another interesting thing revealed by Hubble was where the plasma ejections it observed were coming from. Rather than being ejected from the star's rotational poles – as current stellar models predict- it appeared to be coming from near the equator around the southern hemisphere. In addition to defying conventional wisdom about how stars behave, this activity is also abnormal for Betelgeuse itself.
You see, while Betelgeuse is losing mass at a rate of 30 million times that of the Sun, the recent ejection constituted a loss that was about twice the normal amount of material. Said Dupree:
"All stars are losing material to the interstellar medium, and we don't know how this material is lost. Is it a smooth wind blowing all the time? Or does it come in fits and starts? Perhaps with an event such as we discovered on Betelgeuse? We know that other hotter luminous stars

lose material and it quickly turns to dust making the star appear much fainter. But in over a century-and-a-half, this has not happened to Betelgeuse. It's very unique."

The team also took into account observations conducted by the STELLAr Activity Observatory (STELLA) in Spain, which relies on two 1.2 m (~4 ft) telescopes to combine high-resolution spectroscopy with wide-field images. When Betelgeuse moved into daylight and was no longer visible to Hubble or STELLA, researchers turned to NASA's Solar TErrestrial RElations Observatory (STEREO) to monitor the supergiant's brightness.



Hubble Space Telescope observations from March 2019 to February 2020. Credit: NASA/ESA/A. Dupree (CfA)/E. Wheatley (STScI)

What STELLA revealed was a rippling effect on Betelgeuse's face, apparently caused by the way the surface rose and fell during the star's pulsation cycle. This could have caused the ejected plasma to be propelled through the star's atmosphere. As Klaus G. Strassmeier, director of the Cosmic Magnetic Fields research branch at the Leibniz Institute for Astrophysics Potsdam and a co-author on the study, explained:

"We saw all the absorption lines in the spectrum blue shifted and knew that the star was expanding. When the dimming started, the blue shift became smaller and smaller and actually reverted to a redshift when the star was faintest. So we knew the dimming must have been related in one or another way to the expansion and contraction of the star's photosphere, but it alone could not have caused such great dimming."

Meanwhile, STEREO observed Betelgeuse on five separate days between late June and early August 2020, measuring the star's brightness in comparison to other stars. This revealed something very surprising, which was that the star was unexpectedly dimming yet again! Since the previous dimming happened in February 2020 (and the star's 420 day cycle), this new period of dimming is over a year early.

Looking ahead, Dupree plans to observe Betelgeuse with STEREO again next year when the star will be at its brightest (aka. solar maximum) to see if there are any more unexpected outbursts. This information will go a long way towards determining why Betelgeuse has been experiencing the activity astronomers have seen and whether or not the star could be nearing a supernova.

Artist's impression of a supernova. Credit: NASA

But of course, it's important to note that since Betelgeuse is 725 light-years from Earth, the activity we are seeing today took place back in the year 1305 CE. So if an explosion is in the cards, it would have already happened and we are just waiting to get the memo. As Dupree concluded, there's still much we don't know about stellar behavior prior to a supernova:

"Betelgeuse is a bright star in our galaxy, near the end of its life that is likely to become a supernova. When the star became very faint in February 2020, this was the faintest that it had ever been since measurements began over 150 years ago. The dimming was obvious to everyone when looking at the constellation Orion; it was very weird, Betelgeuse was almost missing."

"No one knows how a star behaves in the weeks before it explodes, and there were some ominous predictions that Betelgeuse was ready to become a supernova. Chances are, however, that it will not explode during our lifetime, but who knows?"

E Mails Viewings Logs and Images from Members.

Viewing Log for 18th of August

I got a pleasant and surprised text from Jon Gale saying he would be up in the Wiltshire area (currently lives in west Wales) for a few days and would I like to do an observing session? We arranged to meet at Uffcott around 21:15 and if cloudy would have a committee meeting instead, this would meaning going to a pub for a chat and possible beer?

Earlier in the evening, the sky had some cloud cover, so I thought I would try and do a sunset session first and then go to the meeting place at Uffcott. When I got to my usual sunset spot (just above the White Horse at Hackpen Hill), I found the sky out to the west clouded over and it was not much better directly above me! After about 20 minutes with the cloud coming towards me, I thought I would head off to the viewing place and wait for Jon to arrive, he arrived by 20:50 J. The sky still had some light to it but there was a lot of cloud around, we could make out both Saturn and Jupiter in some breaks but not much else. So it would be off to the local pub for a committee meeting, I rung the Crown Inn in Board Hinton and asked if they had a free table, 10 minutes later we were at the pub catching up with old times! The drinks last for about an hour then we went outside to examine the skies. We could make out Jupiter very clearly and also the 'Summer Triangle' of stars namely Altair, Vega and Deneb on view overhead and this was with the pub lights on around us!

Once back at Uffcott we got our equipment set up for the evening, tonight I would be using my 15x70 Celestron binoculars on my Manfrotto tripod (if we had any rain coming in I could dismantle my equipment very quickly), Jon produced a new pair of binoculars 15x70 from Helios with both eye cups that you can focus, it is normal for most binoculars to have one eye cup that can be manually adjusted to get correct focus for your eyes? For his tripod he had brought a new Orion 5379 Paragon-Plus Mount and tripod, AKA a Parallelogram mount? A very nice piece of equipment to use!

We started with both Jupiter and Saturn, with Saturn we could just about make out the rings around the planet but nothing else, Jupiter I could make out the four main moons and nothing else. When I first looked at Jupiter I did not make out all of the moons, checking with Jon's binoculars I could make them all out with Ganymede to the east and Io, Europa and Callisto to the west of the planet, so back to mine and looking a bit longer I could finally make them out? Next target was M27, the Dumbbell nebula, you start from the double star Albireo (head of the swan in Cygnus) and go south east until you could to a triangle of four stars with the top two (close together) showing you the way to get to M27? Could not make any real detail out apart from knowing something was there? By now Mars had cleared the eastern horizon, so we turned our attention to the red planet. I was seeing two planets for some reason, looking with Jon's it went down to one? Soon sorted out the problem by widening the eye cups, now all I had was one Mars! In the opposite direction Jon managed to locate M10 (a Globular Cluster, GC) in Ophiuchus, by following his directions I finally got it? Above Ophiuchus was Hercules, even I can find M13 with no help, find the Keystone asterism and the two western stars about a third of the way between them from the top you should come across this G C? Up to Cassiopeia and M52 which is found beyond the 'W' asterism, M103 is in the other direction between the stars Segin and Ruchbah and slightly south? NGC 457, the ET or Owl cluster was next on the list, we could make out the two main stars (the eyes of the Owl) clearly with the other stars much dimmers, the Owl cluster is an Open Cluster as is M103. The Double Cluster, NGC 884 and 869 looked very good to view, object like this is best seen in wide field of views if possible, magnification is not everything viewing the night sky as some advertisements would have you to believe? Final object for the evening was the Coathanger asterism near Albireo, yes this actually looks like a coat hanger, one of the few asterisms where the name actually looks like the object it talks about?

By now is was about 00:30 and I was having trouble with lens misting up with dew, Jon's equipment was okay as he had made some dew shields that fitted over his lens. So we called it a day and was on our travels again, Jon back to the Devizes Travelodge and me back to Swindon!

That is the first viewing session I have had since early May and hopefully I will soon be back into it more often assuming the weather is on my side and not near a full moon?

Clear skies for coming season to all.

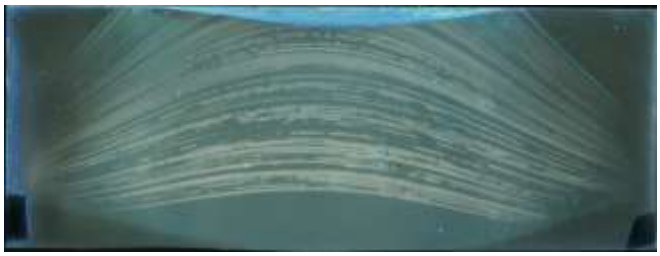
Peter Chappell

Hi Andy,
I hope you are well.
Here are my submissions for the WAS September 2020 newsletter:
23/06/2020
Noctilucent Clouds

5 image panoramas.
Canon 1300D, Samyang F2.8 14mm (effective focal length 23mm)
F4, ISO 800
25/06/2020
Saturn, Jupiter and Milky Way

Ten images converted to tiff in Canon DPP, stacked in Sequator and post processed in Affinity Photo.
Canon 1300D, Samyang F2.8 14mm (effective focal length 23mm)
ISO 6400, F2.8, 10 sec.
30/06/2020

Solargraph from Solstice December 2019 to Solstice June 2020



11/07/2020
Comet Neowise (C/2020 F3)

Canon 1300D, Samyang 14mm, ISO 800, F2.8, 10 sec
20/07/2020

Comet Neowise and Tree

Canon 1100D and Canon F1.8 50mm (effective focal length 80mm) – ISO 6400, F1.8, 8 sec.
Clear Skies.
John Dartnell

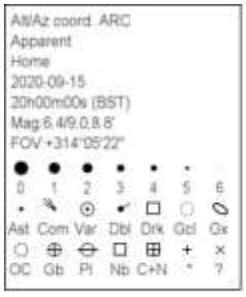
Dear Valued Customer,
At Zoom customers are our number one priority, and we always strive to bring you the best, most secure video meeting experience in the industry. As we have previously communicated, starting **September 27th, 2020**, we will be requiring that all meetings have a Passcode or Waiting Room enabled. We have designed these security measures to give you control over your meeting security options while keeping the join experience as frictionless as possible.

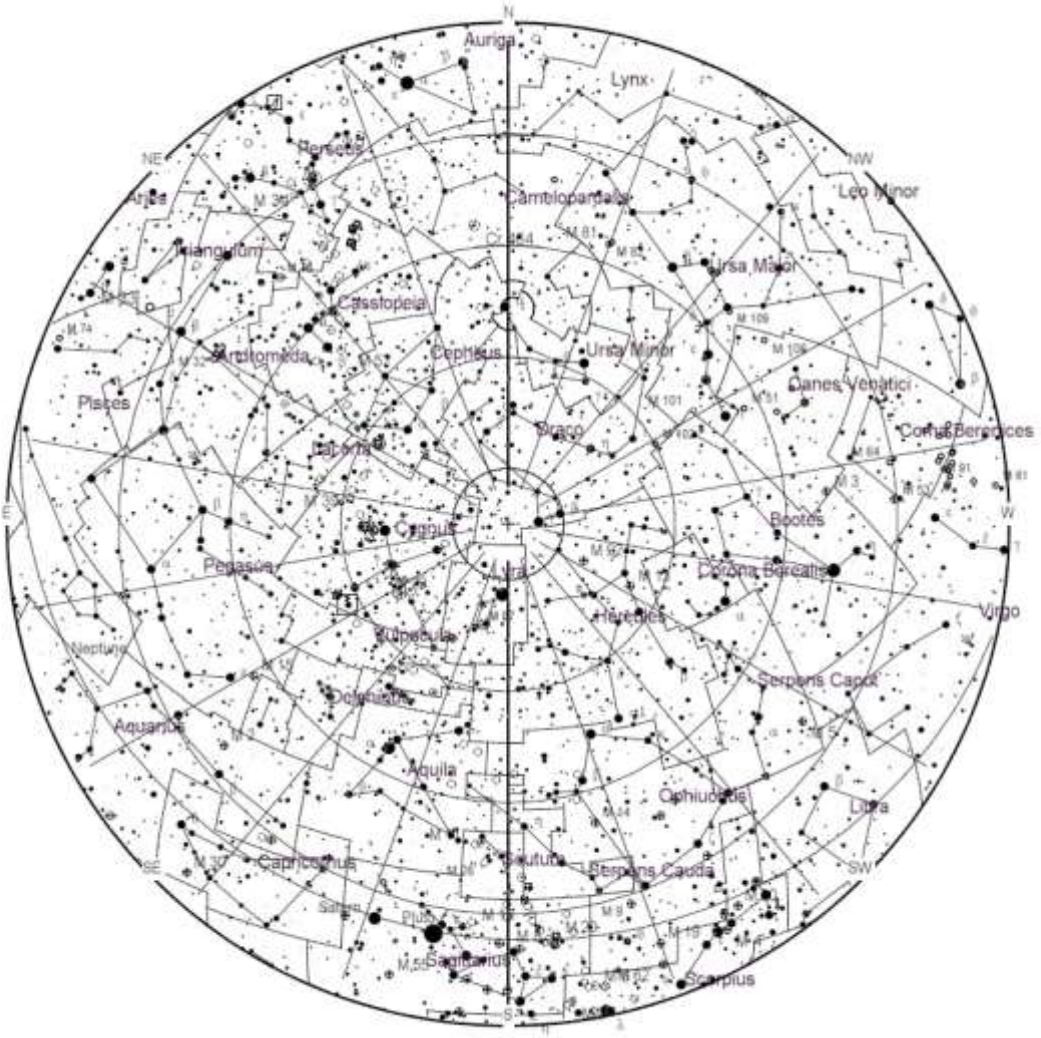
- For meetings that do not have either a Passcode or Waiting Room enabled by **September 27th**, Zoom will enable a Waiting Room for you.
- You can **customize the Waiting Room** experience so individuals within your account, or on an approved list of domains, can bypass the Waiting Room and directly join the meeting.
- You can find meetings that are scheduled without a Passcode or Waiting Rooms by **pulling the following report**.
- We have also improved our Waiting Room notifications so the meeting host can now receive a visual and auditory notification that an attendee has entered the Waiting Room.

For more details, including a comprehensive **FAQ document**, please visit our Support page.

Team Zoom

WHATS UP, SEPTEMBER 2020





September 2 - **Full Moon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 05:23 UTC. This full moon was known by early Native American tribes as the Corn Moon because the corn is harvested around this time of year.

September 11 - **Neptune at Opposition.** The blue giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Neptune. Due to its extreme distance from Earth, it will only appear as a tiny blue dot in all but the most powerful telescopes.

September 17 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 11:00 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

September 22 - **September Equinox.** The September equinox occurs at 13:30 UTC. The Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world. This is also the first day of fall (autumnal equinox) in the Northern Hemisphere and the first day of spring (vernal equinox) in the Southern Hemisphere.

Throughout September Jupiter and Saturn grace our southern skies from evening to midnight.. On 10th and 12th the 24th and 26th the Galilean moons line up in order to the west of the planet and on the 19th they line up to the east.

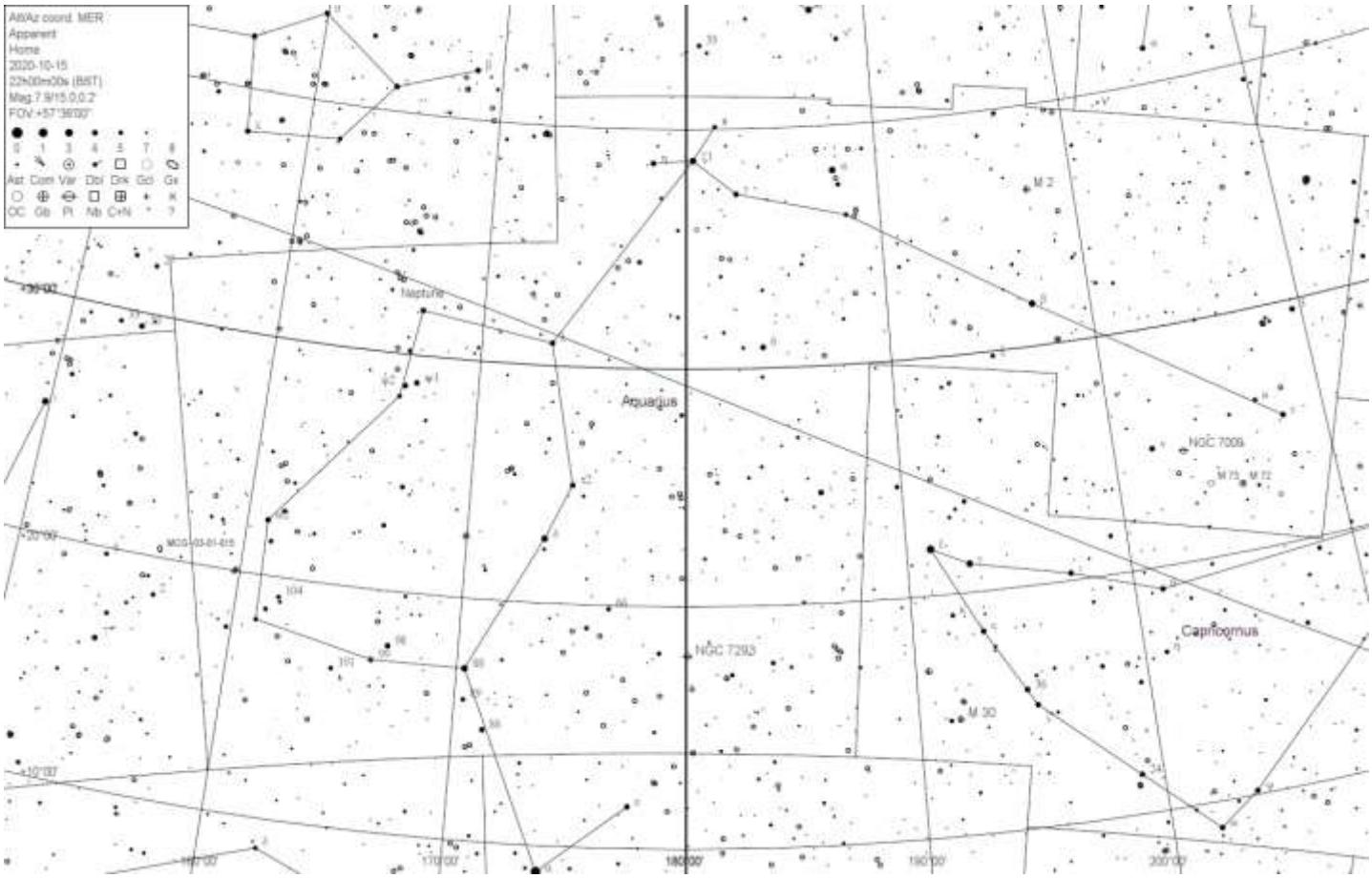
Mars is in a good position for viewing in the evening skies now, moving to opposition in October.

Venus is the bright morning star visible before Sunrise in the East.

As the Sun sets those with a clear south to south western sky will pick up the Milky Way galaxy central region above the horizon.

Clear skies.

CONSTELLATIONS OF THE MONTH: LIBRA



The Aquarius Constellation

In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) compiled a list of all the-then known constellations. This work (known as the *Almagest*) would remain the definitive guide to astronomy and astrology for over a thousand years. Among the 48 constellations listed in this book was Aquarius, a constellation of the zodiac that stretches from the celestial equator to the southern hemisphere.

Also known as the "Water Carrier", Aquarius is bordered by Pegasus, Equuleus and Delphinus at the north, Aquila to the west, Capricornus to the south-west, Piscis Austrinus and Sculptor to the south, Cetus to the east and Pisces to the north-east. Today, it is one of the 88 constellations recognized by the International Astronomical Union (IAU), and is perhaps the most referenced and recognized of all the constellation.

Name and Meaning:

In Greek mythology, Aquarius was associated with the cup bearer of the gods – known to serve wine or water to Zeus. For his role, he was immortalized in the stars. In the ancient Greek version of the Deluge Myth, Aquarius was also identified as the one who unleashed the waters that flooded the Earth. As such, the constellation Eridanus was sometimes identified as being a river poured out by Aquarius.

It may also, together with the constellation Pegasus, be part of the origin of the myth of the Mares of Diomedes, which forms one of The Twelve Labours of Heracles. Its association with pouring out rivers, and the nearby constellation of Capricornus, may be the source of the myth of the Augean stable, which forms another of the labours.

Aquarius is one of the oldest recognized constellations along the zodiac, the sun's apparent path through the sky. It is found in a region often called "The Sea" due to its profusion of watery constellations – such as Cetus, Pisces, Eridanus, etc. Sometimes, the river Eridanus is depicted as flowing forth from Aquarius' watering pot.

History of Observation:

The first recorded mentions of Aquarius are found in the Babylonian star catalogues, where Aquarius is identified as "The Great One" and represents the god Ea himself (who is often depicted holding an overflowing vase). During this time, the Aquarius constellation contained the winter solstice. Hence why Ea was seen as the ruler of the southernmost quarter of the Sun's path, and why the "Way of Ea" corresponded to the period of 45 days on either side of the winter solstice.

Aquarius also had negative connotations in Babylonian society, due to the fact that he was associated with the destructive floods that the inhabitants of the Euphrates and Tigris river basins regularly experienced. In Ancient Egypt, Aquarius was more positively associated with the annual flooding of the Nile. According to their mythology, the Egyptians believed that the riverbanks flooded when Aquarius put his jar into the river, which marked the beginning of spring.

In ancient Greek mythology, Aquarius is sometimes associated with Deucalion, the son of Prometheus who built a ship with his wife Pyrrha to survive an imminent flood. Aquarius is also sometimes identified with Ganymede, the son of Trojan king Tros, who was taken to Mount Olympus by Zeus to act as cup-carrier to the gods. Neighboring Aquila represents the eagle who snatched Ganymede at Zeus' behest (or as Zeus himself in animal form).

In Chinese astronomy, Aquarius is located within the northern quadrant of the sky, which is symbolized as the Black Tortoise of the North. The stream of water flowing from the Water Jar was depicted as the "Army of Yu-Lin". "Yu-lin" translates literally to "feathers and forests", which refers to the numerous foot soldiers from the northern reaches of the empire that were represented by these faint stars.

Other stars corresponded to "The Wall" (*Leibizhen),* "The Cas-

tle" (*Tienliecheng*) and *Loui-pi-tchin* ("The Ramparts"). The asterism that represents the "Water Jar" were also seen to the ancient Chinese as representing *Fenmu* ("tomb"), near to which the emperors' mausoleum (*Xiuliang*) stood. In the 2nd century CE, Ptolemy included Aquarius in the *Almagest*, as one of the then-known 48 constellation. In 1922, the IAU included it in its official list of the recognized 88 constellations.

Notable Features:

Despite its prominent position in the zodiac, Aquarius doesn't have any particularly bright stars. In fact, its four brightest stars are all less than magnitude 2. It's second brightest, Alpha Aquarii (aka. Sadalmelik) is a yellow supergiant named in Arabic for the phrase "the lucky stars of the king". This star has a magnitude of 2.94 (though it has an absolute magnitude of -4.5) and is located 523 light years from Earth.

The brightest star is Beta Aquarii (aka. Sadalsuud), a yellow supergiant that takes its name from the Arabic phrase that means "luckiest of the lucky stars." This star is located 537 light years from Earth, and has an apparent magnitude of 2.89 and an absolute magnitude of -4.5. Gamma Aquarii (Sadachbia) is a blue-white giant located 163 light years from Earth and takes its name from the Arabic phrase *sa'd al-akhbiya* ("lucky stars of the tents"). There are also the blue-white giants Delta Aquarii (Scheat, or Skat) and Epislon Aquarii (Albali), and the white giant binary of Zeta Aquarii.

Aquarius is also home to several Deep Sky Objects. Because of its position away from the galactic plane, the majority of these take the form of galaxies, globular clusters, and planetary nebulae. These include Messier 2 (NGC 7089), one of the largest globular clusters in the Milky Way, located about 33,000 light years from Earth.

Messier 72 also calls Aquarius its home, a globular cluster located roughly 55,000 light years away. And so does Messier 73, an open cluster 2,500 light years from Earth. Two well-known planetary nebulae are also located in Aquarius, including NGC 7009 (also known as the Saturn Nebula) and the famous Helix Nebula (NGC 7293).

Recent research has shown that there are also twelve stars within the Aquarius constellation that possess planetary systems. These include Gliese 876, a red dwarf star system that is located 15 light-years from Earth, and which was the first red dwarf star to be found to possess a planetary system. It is orbited by four planets, including one terrestrial planet (Gliese 876 d) that is roughly 6.6 times the mass of Earth.

Gliese 849 is also located in Aquarius, a red dwarf star orbited by the first known long-period Jupiter-like planet (Gliese 849b). Then there's the multiple-planet system of HD 215152, a white giant that is orbited by the planets HD 215152 b and c – both of which were discovered in 2011 using the radial velocity method. HD 215152 c is the larger one, at 0.0097 Jupiter masses, while b has approximately 0.0087 Jupiter masses.

For those using binoculars and small telescopes, globular cluster M2 is a splendid object to look upon. While it is not quite so well-known, the four star asterism of M73 is also located in Aquarius and is an interesting sight with a small telescope. Small globular cluster, M72 also makes a very interesting small telescope target as well. For those who like binary stars, eta Aqr consists of a tight pair of F stars (F6IV and F3V) and both components are nearly of equal brightness showing 4.59 and 4.42 magnitude.

At a distance of just about 600 light ears the planetary nebula NGC 7293 – known as the Helix Nebula – is the closest of all planetaries and delivers an outstanding and interesting telescope view. Its apparent diameter is about the half of the Moon and is best viewed through binoculars or telescopes at minimal magnifications. It will appears to be a circular hazy patch, but to see it in its full beauty requires long-exposure photographs.

However, NGC 7009 belongs to the brightest planetary nebulae and shows bright and easily detail to the telescope. Because of its shapely resemblance to the planet Saturn it is called Saturn Nebula. In larger scopes, it appears as a bright inner ring surrounded by a patchy, blue colored disk. Small scopes show a misty greenish disk of 8th magnitude, but all show a delightful ansae which makes finding this planetary nebula worth the hunt.

ISS PASSES For Summer 2020 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
01 Sep	**-3.1**	**04:28:37**	**36°**	**S**	**04:29:20**	**42°**	**SSE**	**04:32:32**	**10°**	**E**
02 Sep	-2.0	03:42:49	25°	ESE	03:42:49	25°	ESE	03:44:47	10°	E
02 Sep	-3.8	05:15:46	16°	WSW	05:18:19	84°	S	05:21:43	10°	E
03 Sep	-3.8	04:29:56	50°	SW	04:30:39	71°	SSE	04:34:01	10°	E
04 Sep	-2.5	03:44:06	35°	E	03:44:06	35°	E	03:46:19	10°	E
04 Sep	-3.8	05:17:03	15°	W	05:19:46	85°	N	05:23:09	10°	E
05 Sep	-0.7	02:58:17	12°	E	02:58:17	12°	E	02:58:35	10°	E
05 Sep	-3.8	04:31:14	49°	W	04:32:03	88°	N	04:35:26	10°	E
06 Sep	-2.6	03:45:26	40°	E	03:45:26	40°	E	03:47:43	10°	E
06 Sep	-3.8	05:18:22	14°	W	05:21:10	87°	S	05:24:32	10°	E
07 Sep	-0.7	02:59:40	12°	E	02:59:40	12°	E	02:59:59	10°	E
07 Sep	-3.8	04:32:37	49°	W	04:33:26	86°	N	04:36:49	10°	E
08 Sep	-2.4	03:46:55	36°	E	03:46:55	36°	E	03:49:03	10°	E
08 Sep	-3.7	05:19:53	16°	W	05:22:27	61°	SSW	05:25:47	10°	ESE
09 Sep	-3.9	04:34:16	61°	WSW	04:34:44	75°	SSW	04:38:06	10°	ESE
10 Sep	-1.8	03:48:48	25°	E	03:48:48	25°	E	03:50:22	10°	E
10 Sep	-3.0	05:21:46	19°	W	05:23:36	34°	SSW	05:26:40	10°	SE
11 Sep	-3.2	04:36:28	42°	S	04:36:28	42°	S	04:39:10	10°	SE
12 Sep	-0.9	03:51:23	11°	ESE	03:51:23	11°	ESE	03:51:32	10°	ESE
12 Sep	-2.2	05:24:23	18°	SW	05:24:32	18°	SW	05:26:54	10°	S
13 Sep	-1.2	04:39:34	11°	SSE	04:39:34	11°	SSE	04:39:45	10°	SSE
17 Sep	-1.4	21:21:48	10°	SSW	21:22:32	15°	SSW	21:22:32	15°	SSW
18 Sep	-2.4	20:34:27	10°	SSW	20:37:05	21°	SE	20:37:13	21°	SE
18 Sep	-0.7	22:10:08	10°	WSW	22:10:11	10°	WSW	22:10:11	10°	WSW
19 Sep	-1.8	19:47:26	10°	S	19:49:26	15°	SE	19:51:25	10°	ESE
19 Sep	-2.7	21:22:23	10°	WSW	21:24:39	36°	SW	21:24:39	36°	SW
20 Sep	-3.2	20:34:42	10°	SW	20:37:53	40°	SSE	20:38:55	30°	ESE
20 Sep	-1.0	22:11:09	10°	W	22:11:52	16°	W	22:11:52	16°	W
21 Sep	-2.7	19:47:09	10°	SSW	19:50:07	29°	SSE	19:53:05	10°	E
21 Sep	-3.3	21:23:16	10°	WSW	21:26:01	56°	WSW	21:26:01	56°	WSW
22 Sep	-3.8	20:35:25	10°	WSW	20:38:46	68°	SSE	20:40:04	34°	E
22 Sep	-1.0	22:12:10	10°	W	22:13:00	17°	W	22:13:00	17°	W
23 Sep	-3.5	19:47:38	10°	SW	19:50:55	53°	SSE	19:54:03	11°	E
23 Sep	-3.1	21:24:15	10°	W	21:26:58	55°	W	21:26:58	55°	W
24 Sep	-3.8	20:36:20	10°	W	20:39:42	89°	NW	20:40:53	38°	E
24 Sep	-0.8	22:13:08	10°	W	22:13:49	15°	W	22:13:49	15°	W
25 Sep	-3.8	19:48:25	10°	WSW	19:51:47	81°	SSE	19:54:46	13°	E
25 Sep	-2.8	21:25:13	10°	W	21:27:41	46°	W	21:27:41	46°	W
26 Sep	-3.8	20:37:16	10°	W	20:40:39	85°	N	20:41:32	47°	E
26 Sep	-0.6	22:14:05	10°	W	22:14:28	13°	W	22:14:28	13°	W
27 Sep	-3.8	19:49:19	10°	W	19:52:42	85°	N	19:55:23	15°	E
27 Sep	-2.3	21:26:08	10°	W	21:28:18	36°	W	21:28:18	36°	W
28 Sep	-3.8	20:38:09	10°	W	20:41:32	79°	SSW	20:42:08	57°	ESE
29 Sep	-3.8	19:50:12	10°	W	19:53:34	89°	SSW	19:55:58	18°	E
29 Sep	-1.8	21:27:03	10°	W	21:28:53	26°	WSW	21:28:53	26°	WSW
30 Sep	-3.3	20:39:01	10°	W	20:42:18	50°	SSW	20:42:45	46°	S
01 Oct	-3.6	19:51:00	10°	W	19:54:21	65°	SSW	19:56:38	19°	ESE
01 Oct	-1.2	21:28:12	10°	W	21:29:33	17°	WSW	21:29:33	17°	WSW
02 Oct	-2.3	20:39:58	10°	W	20:42:53	28°	SSW	20:43:29	26°	SSW
03 Oct	-2.6	19:51:50	10°	W	19:55:00	38°	SSW	19:57:28	15°	SE
04 Oct	-1.2	20:41:25	10°	WSW	20:43:16	14°	SW	20:44:27	12°	SSW
05 Oct	-1.5	19:52:54	10°	W	19:55:27	20°	SW	19:58:00	10°	SSE
06 Oct	-1.9	19:04:37	10°	W	19:07:34	28°	SSW	19:10:30	10°	SSE
08 Oct	-0.9	19:05:56	10°	WSW	19:07:52	15°	SW	19:09:48	10°	S

END IMAGES, OBSERVING AND OUTREACH

Sometimes things just happen. On July 11th I began observing to search for comet Neowise from home, but it was an early morning object then, and low to the sky amongst the trees. Speculatively I drove out to the West Kennet Avenue near Avebury, and on the way was dismayed to see what looked like horrible Swindon light pollution to the North (I was driving so only getting glimpses). When I arrived I realised I was getting one of the best Noctilucent cloud displays of the summer. AND with a wide angle could also capture the comet with one of the Avenue stones in view! Luck, but played for! Andy Burns, Nikon D850, 24mm lens.

September Observing Suggestion

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

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

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

Most target objects can be found around due south at about 2200.

Where To Look This Month: Cassiopeia
Just select 'What's Up' link below to get the PDF file.
What's Up Link: WAS_September_2020.pdf

OUTREACH

On hold during Isolation/Social Distancing