NWASNEWS

Volume25, Issue 2

October 2019

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies

Committee Changes

A couple of changes to the committee positions from the AGM to report. Tony Vale has stepped back from the observing coordinator alongside Jonathan Gale and Chris Brooks has volunteered to step in, and is working on the viewing night list for the year, although a family bereavement means he will be supplying a more complete list in the next few days. He will also post these on the Facebook members page and the website via Sam.

Peter has completed the speaker list for the year, see page 2, February is waiting confirmation.

Note the Wiltshire Society page carries our logo that used to appear on the meetings newsletter.

Hopefully the correct toner cartridges for me printer will arrive in time for me to print some of this issue (wrong cartridges supplied by PC World when I bought my reserve printer gave me a real headache last month.

The other position to be filled at the AGM was the position of chairman. I have stepped back into the post for a year while some members think about options running forward but thank you for year in office Keith.

The good news is that I have had 2 members ask to be considered for next year.

On the Wiltshire Society page is a for sale item, an NEQ6 skywatcher mount and battery. This is barely used, but Philip Proven is stepping away from viewing and has this for sale. Top notch mount! Unfortuneately Philip has had to go into hospital for 10 days while they sort out an infection around his pacemaker operation site, but he assures me he is very confident the doctors have found the type of virus and are hitting with intravenous drip. I am sure we all wish him well.

Clear skies Andy Burns.

Saturday 5th October will be quarter Moon. It is also International Moon Observing Night.

September I managed to image the Moon from the 4th to 28th September, with only 2 day/nights with no Moon visible.
Most of these I did with a bridge camera with a large zoom lens built in. The Nikon Coolpix P1000. I wouldn't recommend it for star or deep sky images, but for the Moon (and bird photography) it is very good.

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

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

Meetings 2018/2019Season.

NEW VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

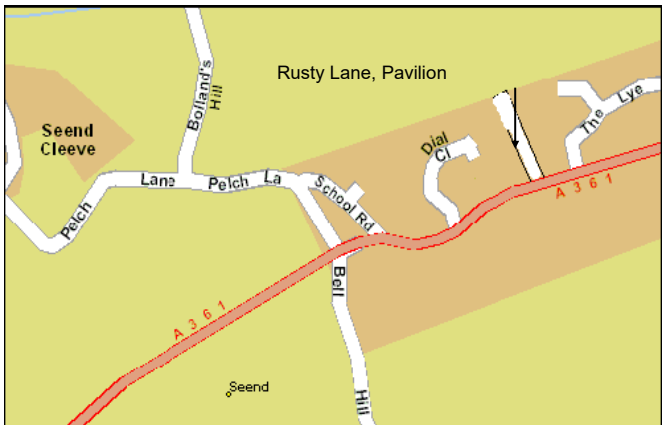
Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

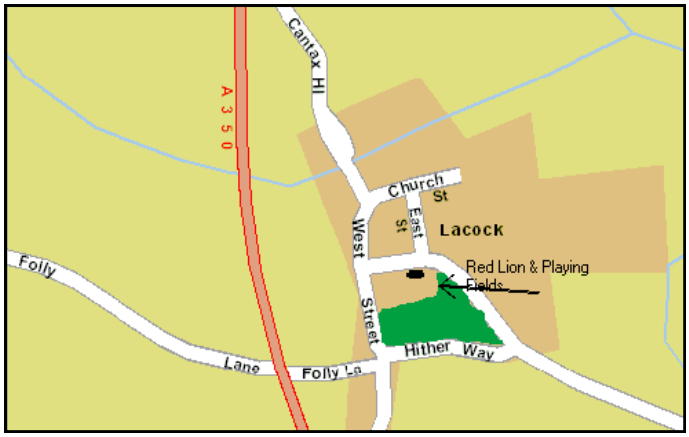
Andy Burns Chair, anglesburns@hotmail.com
Andy Burns Outreach and newsletter editor.
Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)
Philip Proven (Hall coordinator) Dave Buckle (Teas)
Peter Chappell (Speaker secretary)
Nick Howes (Technical Guru)
Observing Sessions coordinators: Jon Gale,
Web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

NEW SEASON 2019/2020

1 Oct Dr Chris Pearson 'Ariel and Alien Worlds: Enabling Planetary Science Across Light Years'.
5 Nov Andrew Lound 'Uranus – George's Planet'.
3rd Dec Dr Dirk Froebrich 'Making Stars and Planets – The Hoys-Caps Citizen Science Project'.
2020
7th Jan Open Forum/Beginners Meeting.
4th Feb TBA.
3rd Mar Dr Lilian Hobbs 'Armchair Messier Marathon'.
7th Apr Pete Williamson 'The Moon and Moons of the Solar System'.
5th May Martin Griffiths 'The Habitable Zone – What is it and How is it determined'.
2nd Jun Paul Money 'Triumphs of Voyager (part 2) – Where no probe has gone before'.



Observing Sessions see back page



Dr Chris Pearson

Rutherford Appleton Laboratory's Space Science department (RAL Space) has a long history. It has been involved with more than 200 instruments either flown or ground-based, covering the spectrum from radio to gamma-rays, and studies of everything from the cosmic microwave background to exoplanets. Herschel, The James Webb Space Telescope (JWST), Solar Dynamics Observatory, Solar Orbiter, Sentinel, Rosetta and Ariel all flew or will fly with RAL Space instruments. Dr Pearson's talk covered a few of the highlights of the programme in some detail.

The first exoplanets were discovered around pulsars in the mid-1990's. There are now around 3700 known exoplanets, many in multiple systems, and it seems our Solar System is not typical. Many exoplanets are "hot Jupiters": giants orbiting close to their star and losing their atmospheres. There are also "lava worlds"; high-carbon "diamond planets"; and a few "new Earths" orbiting in the so-called "Goldilocks zone" where liquid water can exist. Our closest star, Proxima Centauri, has Earth-like planets. Several new missions are planned to seek and study exoplanets, and RAL Space has been selected as engineering lead and project management for the ARIEL mission. This will study the atmospheres of exoplanets that transit their star by looking for changes in the star's spectrum. It is a very challenging mission requiring extreme stability in the instrumentation.

Members for sale/wanted

Hi Andy. I tried to put my for sale stuff on the web page but was unavailable.

Briefly this is. For sale. I EQ6pro. Go to equatorial mount (hardly used)wth controls. 1 Sealy Power Products Road Start. battery. Model RS102 v2. All for £860.00. Inspection anytime just across Rusty Lane in my garage. Phone 01380828407/ philipproven@gmail.com

Please advise if you can put in NL or not

As ever Philip Proven

Philip is in hospital until next weekend so please contact after 7th October.

Swindon's own astronomy group

October Meeting: Robert Slack

Rob Slack

Rob will be giving at talk on: 'The Grand Tour - Mission to the Giants' about the Pioneer and Voyager missions to the outer planets.

Rob has been a member of Swindon Stargazers from its conception and is a keen practical astronomer and astrophotographer, he also plays a significant role in outreach on behalf of the club.

New Logo

Organisations and event organisers quite often ask us if we have logo to place on their advertising, up until now we have not had one, but now we have designed one to fill this small gap, 'hope you like it!

Ad-hoc viewing sessions

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

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!

Friday 18 October 2019

Programme: Robert Slack: The Grand Tour

Friday 15 November 2019
Programme: TBA

Friday 13 December 2019
Programme: TBA

Meeting Dates for 2020
Friday 7 January
Programme: Chris Starr FRAS MBIS:. Introduction to the Night Sky for Beginners

Friday 21 February
Programme: Dr Jane Clark: Orbits in the Solar System

Friday 7 March
Programme: AGM / Bob Gatton: The Red Planet
Friday 17 April
Programme: Gary Poyner - Variable Stars around the Perseus Double Cluster

Friday 15 May
Programme: Mike Foulkes: Herschel's Planet
Friday 19 June
Programme: Graham Bryant - Pluto from Myth to Discovery

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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Secretary: Hilary Wilkey

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BECKINGTON ASTRONOMICAL SOCIETY

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

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

Our Committee for 2016/2017 is

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

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

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

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

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm.

STAR QUEST ASTRONOMY CLUB

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

Winter Stargazing Tips: Stay Warm and Cozy!

Getting prepared for our winter sky viewing.

Orion, Taurus, the Pleiades, Sirius, the Andromeda Galaxy, the Double Custer in Perseus: these are just a few of the gorgeous sights that are at their peak in the winters of the Northern Hemisphere, not to mention the clockwork actions of the Moon and planets. But how can you observe and stay comfortable outside when the weather seems detemrined to turn you into a popsicle?

1. Layers are your friend!
You may already know this, but remember to wear multiple layers of clothes! A super warm coat won't help that much if all you are wearing underneath is a t-shirt. At the same time, moving around during your setup and observing may actually heat you up to an uncomfortable degree, so being able to peel off a sweater or overcoat would be very welcome.

2. Warm, wool socks
Thick cozy socks are a must, especially as the night wears on. Your feet will thank you, especially if you are wearing good boots! Which brings us too...

3. Waterproof boots
You will want warm boots, and if there is snow, make sure your boots are also waterproof. Any water soaking through your shoes to your boots is a sure way to make your toes icy and prematurely end your observing.

4. Clear out your observing area
Is there snow on the ground where you usually set up? Bring a shovel and clear it out, even if there is just an inch or two of the white stuff. Your equipment and toes will thank you.

5. Blankets
Did you bring a blanket? Good. Even if you think you won't need one...you very well may want one after the first hour or so, especially if you are seated very still.

6. Gloves
Pack your gloves! Some astronomers prefer fingerless gloves that allow them to work on their instruments while outside, while others prefer combo mitten-gloves that allow you to flip the ends of the mittens off for fingerless glove access. Remember, you will be handling lots of cold metal as you set up your equipment in the cold so if you don't want your fingers going numb within minutes, gloves are a must!

7. Heat pads
Chemical heating pads are your friend. Stick these little beauties into your gloves and boots to stay warm. Some heating pads now offer re-chargeable electrical heating-just make sure they are charged before you leave the house!

8. A big goofy hat and earmuffs
A hat with ear flaps? Big fuzzy earmuffs? You will definitely want these! While they may look a bit silly, you will be toasty inside, with nice warm ears rather than frigid lobes in danger of frost-bite. Besides, you will be in the dark: who cares what you look like?

8. A warm thermos
A thermos full of your favorites warm liquid-hot chocolate, soup, coffee, tea- is your best friend during these long winter nights.

One final thing to remember: however cold you think you are, there is probably someone somewhere else who is in an even colder location...like, say, viewing the Aurora in winter Iceland. –30C with wind chill.

With these tips you are sure to have a much warmer and cozier time checking out the beautiful jewels of the winter night. Stay warm, and don't let the frost bite!

SPACE NEWS FOR October 2019

Our Facebook page carries a lot of these news items throughout the month.

Confirmed. Fossils That Formed 3.5 billion Years Ago, Really are Fossils. The Oldest Evidence of Life Found So Far

The title of Earth's Earliest Life has been returned to the fossils in the Pilbara region of Australia. The Pilbara fossils had held that title since the 1980s, until researchers studying ancient rocks in Greenland found evidence of ancient life there. But subsequent research questioned the biological nature of the Greenland evidence, which put the whole issue into question again.

Now a new study of the Pilbara fossils has identified the presence of preserved organic matter in those fossils, and handed the 'Ancient Life' crown back to them.

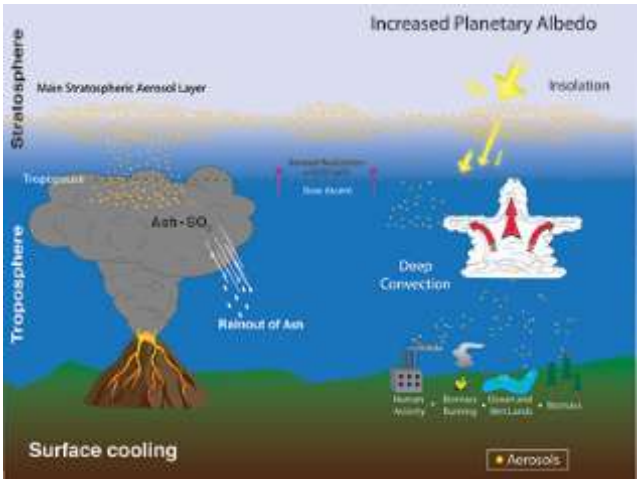
Tracking Twilight: 'Purple Sunset Effect' Seen Worldwide

Has twilight looked at little… *purple* to you as of late? The 'purple sunset' effect is subtle, but currently noticeable on a clear evening. Sunsets are always colourful events, as the Sun's rays shine through a thicker layer of the atmosphere at an oblique angle, scattering out at longer, redder wavelengths. When the air is clear and relatively dust free, this effect is at a minimum… but when the upper atmosphere becomes saturated with dust particles and aerosols, the sky can erupt in a panoply of colours at twilight.

Two natural events are suspected as the main source of the violet twilight currently seen worldwide: the eruption of the Raikoke volcano Kuril Islands, followed by eruption of the Ulawun volcano in Papua New Guinea this past summer. Both eruptions packed a punch, sending dust and ash into to stratosphere topping out at 60,000 feet (18,300 meters).

Raikoke erupts… Credit: NASA/Earth Observatory.

Why purple sunsets? Well, it's all about particle size. Fine volcanic aerosols that stay suspended in the stratosphere for weeks after an eruption have a knack for scattering out blue light from ordinary sunset red, giving it a resulting violet hue. Often, the onset of a yellow arch close to the horizon about 15 minutes after local sunset is followed by a purple band just after. We just passed the equinox on September 23rd, and 20 minutes post-sunset/pre-sunrise computes to the end (or start) of civil twilight, when the Sun is five degrees below the horizon.



The passage of aerosols into the stratosphere, and its overall effect on planetary albedo (reflectivity). Credit: NASA.

A recent study also looked at the fact that it's actually tough to peg when local sunrise and sunset occurs to an accuracy of greater than five minutes or so.

Note that this action is also noticeable on Mars, where sunsets seen by NASA's Curiosity Rover are bluish in colour due to particles kicked up by Martian dust storms.

A purple sunset seen from downtown Norfolk, Virgina. Credit: Dave Dickinson

Volcanoes may not be the only culprit. Benjamin Knispel on Twitter mentions that European observers were already noticing the purple cast of twilight this summer, *before* the eruptions took place. Ongoing fires in Indonesia, the Amazon, and the Siberian Arctic may be exacerbating the situation, adding dust and greenhouse gasses to an already saturated atmosphere. Another modern atmospheric phenomenon seen at high latitudes during the summertime in recent years are noctilucent clouds. One proposed idea was that noctilucent

clouds were linked to the copious amounts of aerosols deposited in the atmosphere during the Space Shuttle program, which ended in 2011. Noctilucent clouds, however, seem to be with us to stay.

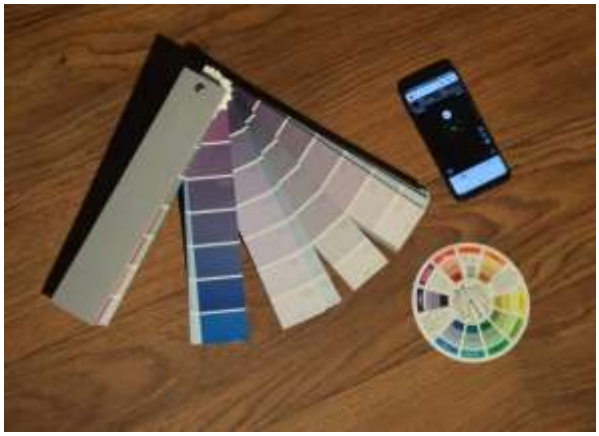
A more pedestrian sunrise… as seen from the ISS. Credit: NASA

The amount of aerosols and dust suspended in the upper atmosphere can also have a dramatic effect on the appearance of the Moon during a total lunar eclipse, as well. For example, the Moon nearly disappeared during totality following the eruption of Mount Pinatubo in 1991. Keep an eye out for this phenomenon during the next total lunar eclipse, favouring the Pacific Rim region on May 26th, 2021.

A crescent Moon against a purple twilight. Image credit and copyright: Hisayoshi Kato.

Seeing the Colour Purple at Twilight

Are you really seeing purple sunsets? Would you have noticed the difference at a casual glance? As with anything else these days, there's an app for that. One great free application is known as Colour Grab. Simply point your phone's camera at an object (or the sky), and it will tell you exactly what colour it sees, complete with shade and specific colour code. An old school way to do this is by using a colour wheel (available at most art stores) or paint swatches, available (again, for free) from most paint and hardware stores, and comparing it in the field to what you see in the sky.



Adventures in color-spotting: tools of the trade. Credit: Dave Dickinson

Are purple skies a result of volcanic activity, or harbingers of the reality of living in a warmer world? As with everything in the Universe, the answer probably lies somewhere in the complex middle. For now, raise a glass of (plum) wine, to the colourful purple twilight sky.

Musk Presents the Orbital Starship Prototype. Flights will Begin in Six Months

On Saturday, Sept. 28th, SpaceX founder Elon Musk presided over a media circus at their testing facility in Boca, Chica, Texas. With the fully-assembled *Starship Mk.1* as his backdrop, Musk shared the latest updates on the *Starship* launch system, which include a timetable for when the first test-flights, commercial flights and crewed flights will commence. Sometime next year, he promised, it will begin taking passengers to space!

The event, which was live-streamed, began at 07:00 PM local time (05:00 PM PDT; 08:00 PM EDT). Musk kicked things off by addressing the challenges that come with trying to escape Earth's gravity well and going to space in a way that is cost-effective. He also took the time to acknowledge that it was 11 years ago, on that very day, that SpaceX conducted its first successful launch with their *Falcon 1* rocket (after three failed attempts).

That milestone proved to be the difference between SpaceX – a fledgling company founded six years prior (in 2002) – going bankrupt and becoming the powerhouse that it is today. A *Falcon 1* rocket was also set up beside the finished *Starship Mk.1* prototype to provide a sense of scale and to act as a visual reminder of just how far the company come.

The assembled Mk. 1 picture at night. Credit: SpaceX

But as Musk went on to say, the learning curve was still very steep and it took a lot of work for him and his colleagues to get to the point where they could retrieve their rockets and make them reusable. As Musk described those early, heady days, before they had mastered retrievability:

"We were very naive, obviously, very naive on many levels back then because we did actually try to recover the first stage. So the first stage had a parachute on it and we thought, 'okay, just pop the parachute when it comes back into the atmosphere and it'll land somewhere in the ocean and we'll fish it out of the ocean with a boat'. This does not work.

"When the rocket comes in from space, that first stage is coming in like Mach 10 to 12. And it hits the atmosphere like its a concrete wall, and boom! You actually have to orient the rocket carefully, you have to have aerodynamic surfaces, you have to do an entry burn to slow it down, then you've got to guide it through the atmosphere and do a propulsive landing. This took us many attempts… I think it might have taken us fourteen attempts before we successfully landed the rocket."

This was followed by a footage reel of the *Grasshopper* test vehicle, a single-engine variant of the *Falcon 9* that was used to conduct the first "hop tests". After many tests that brought the vehicle to greater and greater altitudes (and no crashes), the company had finally reached the point where they knew they could retrieve the first stages of their rockets.

The Mk.1's interior, showing its three Raptor engines. Credit: SpaceX

This, Musk said, is the same thing that the *Mk. 1* will do now that its three Raptor engines have been integrated and the hull has been joined. "This thing is going to take off, fly to 65,000 feet – about 20 km – and come back and land in about one to two months," he said. "So that giant thing, it's gonna be pretty epic to see that thing take off and come back."

In short, *Starship Mk.1* and maybe the *Mk.2* – which is still being assembled at the SpaceX facility in Cape Canaveral, Florida – could be conducting hop tests within eight weeks (late October or November). If all goes well, the orbital-class *Starship* prototypes could be conducting flights to space in six months from now and carrying its first passengers there sometime in 2020.

What followed was the much-anticipated updated design of the *Starship*, which measures 50 meters (165 feet) and has two steerable fins on its forward and aft sections (rather than three fixed fins that act as landing struts as well). The aft section also includes four smaller, fixed fins, with two mounted on each side.

He also showed how the updated design would fare when entering an atmosphere, which he described as a "controlled fall". The steerable fins are intrinsic to this, creating drag so the spacecraft can shed speed. They also help the rocket reorient itself so its engines can then fire and bring the *Starship* in for a soft landing.

According to the updated design, the finished *Starship* will have a dry mass of approximately 120 tonnes (132 US tons) and weigh 150 tonnes (165 US tons) fully-loaded. This will be made possible thanks to six Raptor engines, three that are optimized for sea level and generate 200 tonnes (220 US tons) of thrust and three that optimized for vacuum and generate 220 tonnes (242.5 metric tons).

The Raptors are also capable of reorienting themselves (aka. gimbaling) to optimized efficiency and allow the craft to move laterally. Other items of note included the updated hull design, which relies on 301 stainless steel to maximize heat resistance, provides a greater strength-to-weight ratio under cryogenic conditions (aka. in space), and is more cost-effective and lightweight than carbon fiber (which was originally proposed) or aluminum-lithium.

An added bonus is that its easy to weld, as demonstrated by the fact that SpaceX engineers were able to assemble it outside without a factory. Addressing a point made earlier, Musk also admitted that this material could be reused once the *Starship* gets to its destination:

"On Mars, you can cut that up, you can weld it, you can modify it, no problem! You are out there on the Moon or Mars. You want something that you can modify, that you can cut up and use for other things. That's like for sure a great thing! Obviously, I am in love with steel."

Next up was the updated design of the *Super Heavy* booster, which will measure 68 meters (223 feet) in length and 9 meters (feet) in diameter. The booster will be equipped with 37 Raptor engine and have a propellant capacity of 3,300 tonnes (3,638 US tons) of liquid methane and liquid oxygen (LOX) fuel. The updated version also includes four actuator fins on the upper section and 6 fixed rear fins (which serve as legs).

Once integrated with the *Starship*, the entire launch system will stand 118 meters (387 feet) tall. Simulations followed that showed the *Starship* and *Super Heavy* taking to space and refueling with a tanker ship in orbit (shown above). This process, Musk demonstrated, will consist of a *Starship* and tanker rendezvousing in orbit and connecting their rear sections to each other.

Combined with reusability, orbital refueling will be intrinsic to Musk's long-term goal of establishing a base on the Moon and on Mars. In this vein, Musk shared some updated images of what a future base on the Moon, a self-sustaining city on Mars (aka. Mars Base Alpha), and missions to deep space (like Saturn) would look like using the *Starship* as a transport system.

Musk then wrapped things up (before a short break that was followed by an extended Q&A session) by reiterating why he hopes to see humanity become an "multiplanetary species". According to Musk, humanity is (to the best of our knowledge) the only sentient species in the galaxy, and we only have a certain amount of time to get out there and plant the seed of our civilization before its too late.

Artist's rendering of the Starship traveling to deep-space locations like Saturn. Credit: SpaceX

This is especially crucial, he added, considering that it took about 4.5 billion years for us to get to the point where life could contemplate expanding into space and colonizing other planets. Meanwhile, the Sun is going to gradually get bigger and hotter over time and (even in the absence of global warming) it will eventually overheat the Earth and make life here untenable.

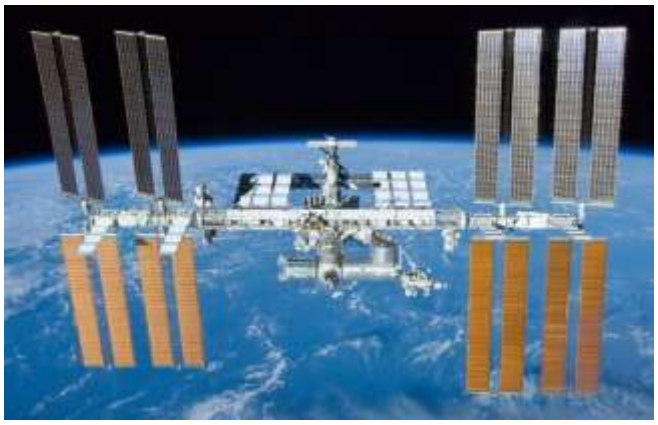
As Musk summarized, this gives us just a few hundred million years to plant the seed of human consciousness and civilization elsewhere:

"So it appears that consciousness is a very rare and precious thing and we should take whatever steps we can to preserve the light of consciousness. And the window has been open only now after four and a half billion years… that's a long time to wait and it might not stay open for long. I think we should become a multi-planet civilization while that window is open… I think we should really do our very best to become a multi-planet species and to extend consciousness beyond Earth, and we should do it now. Thank you."

As with just about everything Musk says, much of what he proposed and predicted with this latest update (including the timetables) might seem a bit optimistic. However, Musk has every reason to be optimistic at this point. After many years of struggling, SpaceX has delivered on reusability with the *Falcon 9* and *Falcon Heavy* and inspired other aerospace companies to follow a similar path.

With their latest launch vehicle coming together nicely, Musk is almost at the point where he can deliver on the very promise SpaceX was founded on seventeen years ago – to reinvigorate space exploration by lowering costs and achieve the crewed exploration of Mars.

Mice That Spend a Month in Space Were Able to Reproduce Once They Got Back to Earth



A team of Japanese researchers have used sperm from mice that spent time aboard the International Space Station (ISS) to fertilize female mice back on Earth. While previous research has shown that freeze-dried mouse sperm stored in space can experience radiation damage, these results show that the sperm from live mice may not suffer the same damage.

Astronomers Have Found a Place With Three Supermassive Black Holes Orbiting Around Each Other

Astronomers have spotted three supermassive black holes (SMBHs) at the center of three colliding galaxies a billion light years away from Earth. That alone is unusual, but the three black holes are also glowing in x-ray emissions. This is evidence that all three are also active galactic nuclei (AGN,) gobbling up material and flaring brightly.

This discovery may shed some light on the "final parsec problem," a long-standing issue in astrophysics and black hole mergers.

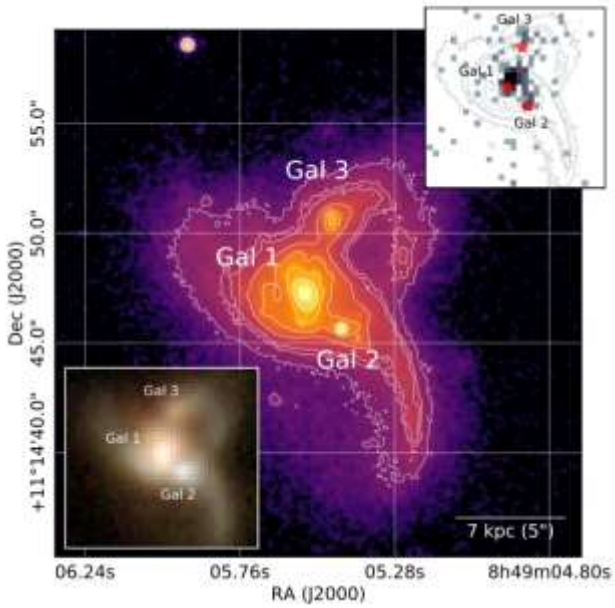
Astronomers found the three SMBHs in data from multiple telescopes, including the Sloan Digital Sky Survey (SDSS,) the Chandra X-ray Observatory, and the Wide-field Infrared Survey Explorer (WISE.) The three black holes are wrapped up in an almost unimaginably epic event; a merger of three galaxies. These triplet mergers may play a critical role in how the most massive black holes grow over time.

The astronomers who found it were not expecting to find three black holes in the center of a triple-galaxy merger.

"We were only looking for pairs of black holes at the time, and yet, through our selection technique, we stumbled upon this amazing system," said Ryan Pfeifle of George Mason University in Fairfax, Virginia, the first author of a new paper in The Astrophysical Journal describing these results. "This is the strongest evidence yet found for such a triple system of actively feeding supermassive black holes."

Triple black hole systems are difficult to spot because there's so much going on in their neighbourhood. They're shrouded in gas and dust that makes it challenging to see into. In this study, it took several telescopes operating in different parts of the electromagnetic spectrum to uncover the three holes. It also took the work of some citizen scientists.

They're not only difficult to spot, but rare. "Dual and triple black holes are exceedingly rare," said co-author Shobita Satyapal, also of George Mason, "but such systems are actually a natural consequence of galaxy mergers, which we think is how galaxies grow and evolve."



The main image is an archival Hubble Space Telescope image. The top right corner is an image from Chandra X-ray Observatory data. The lower left image is a lower resolution Sloan Digital Sky Survey image. Image Credit: Hubble/ Chandra/SDSS/Pfeifle et. al., 2019.

The SDSS was the first to spot this triple-merger in visible light, but it was only through Galaxy Zoo, a citizen science project, that it was identified as a system of colliding galaxies. Then WISE saw that the system was glowing in the infrared, indicating that it was in a phase of galaxy merger when more than one of the black holes was expected to be feeding.

The Sloan and WISE data were just tantalizing clues though, and astronomers turned to the Chandra Observatory and the Large Binocular Telescope (LBT) for more confirmation. Chandra observations showed that there were bright x-ray sources in the center of each galaxy. That's exactly where scientists expect to find SMBHs.

More evidence showing that SMBHs were there arrived from Chandra and NASA's Nuclear Spectroscopic Telescope Array (NuSTAR) satellite. They found evidence of large amounts of gas and dust near one of the black holes. That's expected when black holes are merging. Other optical light data from the SDSS and the LBT provided spectral evidence that's characteristic of the three SMBHs feeding.

Artist illustration of the Chandra X-ray Observatory. Chandra is the most sensitive X-ray telescope ever built, and played a large role in this discovery. Credit: NASA/CXC/NGST

"Optical spectra contain a wealth of information about a galaxy," said co-author Christina Manzano-King of University of California, Riverside. "They are commonly used to identify actively accreting supermassive black holes and can reflect the impact they have on the galaxies they inhabit."

With this work, the team of astronomers have developed a way to find more of these triple black hole systems. "Through the use of these major observatories, we have identified a new way of identifying triple supermassive black holes. Each telescope gives us a different clue about what's going on in these systems," said Pfeifle. "We hope to extend our work to find more triples using the same technique."

They may have also shed some light on the final parsec problem.

The Final Parsec Problem

The final parsec problem is central to our understanding of binary black hole mergers. It's a theoretical problem that says when two black holes approach each other, their excessive orbital energy stops them from merging. They can get to within a few light years, then the merging process stalls.

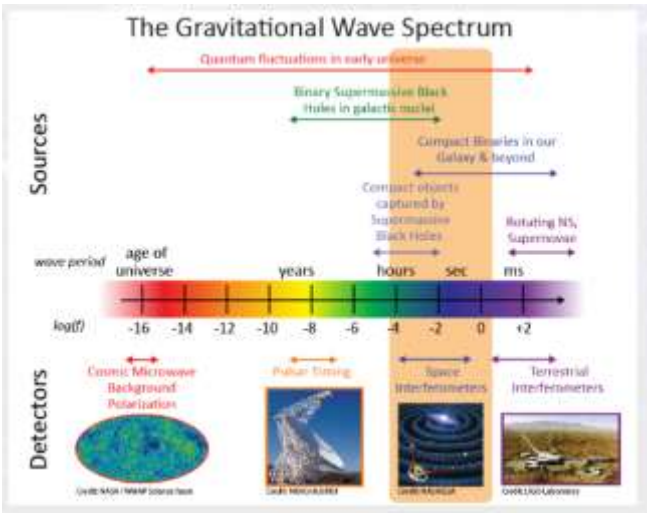
When two black holes initially approach each other, their hyperbolic trajectories carry them right past each other. Over time, as the two holes interact with stars in their vicinity, they slingshot the stars gravitationally, transferring some of their orbital energy to a star each time they do it. The emission of gravitational waves also decreases the black holes' energy.

Eventually the two black holes shed enough orbital energy to slow down and approach each other more closely, and come to within just a few parsecs of each other. The problem is, as they close the distance, more and more matter is ejected from their vicinity via sling-shotting. That means there's no more matter for the black holes to interact with and shed more orbital energy. At that point, the merging process stalls. Or it should.

Yet astrophysicists know that black holes merge because they've witnessed the powerful gravitational waves. In fact, LIGO (Laser Interferometry Gravitational-Wave Observatory) is discovering a black hole merger about once a week. How they merge with each other at the end is called the final parsec problem.

The team behind this study thinks that they might have an answer. They think that a third black hole, like they've observed in this system, could provide the boost needed to get two holes to merge. As a pair of black holes in a trinary system approach each other, the third hole could influence them to close the final parsec and merge.

According to computer simulations, about 16% of pairs of supermassive black holes in colliding galaxies will have interacted with a third supermassive black hole before they merge. Those mergers would produce gravitational waves, but the problem is that those waves would be too low-frequency for LIGO or the VIRGO observatory to detect.



The spectrum of gravitational waves and the instruments that observe them. LISA is a space interferometer and can detect things that LIGO can't. Image Credit: ESA/NASA/LISA

To detect those, scientists may have to rely on future observatories like LISA, ESA/NASA's Laser Interferometer Space Antenna. LISA will observe lower frequency gravitational waves than LIGO or VIRGO and is better-equipped to find super-massive black holes merging.

The paper presenting these results is titled "A Triple AGN in a Mid-Infrared Selected Late Stage Galaxy Merger."

This Summer's Asteroid Near-Miss Helped Greenlight NASA's NEOCam Mission to Search the Skies for Killer Spacerocks

Last July, a once-in-a-lifetime event happened. Not the good kind; the football-field-sized-asteroid near-miss kind. And that near miss is the catalyst for a renewed effort from NASA to detect more dangerous space-rocks that might threaten Earth.

Last summer's near-miss asteroid was named 2019 OK, and it passed within about 77,000 km (48,000 miles) of Earth. It managed to slip past all of our detection methods and came within 0.19 lunar distances to Earth. In astronomical terms, that is remarkably close.

We only had 24 hours notice that the asteroid was coming, thanks to a small telescope in Brazil that spotted it. That near miss has sparked a renewed conversation on planetary defense and on NASA's role in it.

It also left people wondering how this could happen.

Elliptical Galaxy Messier 110 Has a Surprising Core of Hot Blue Stars

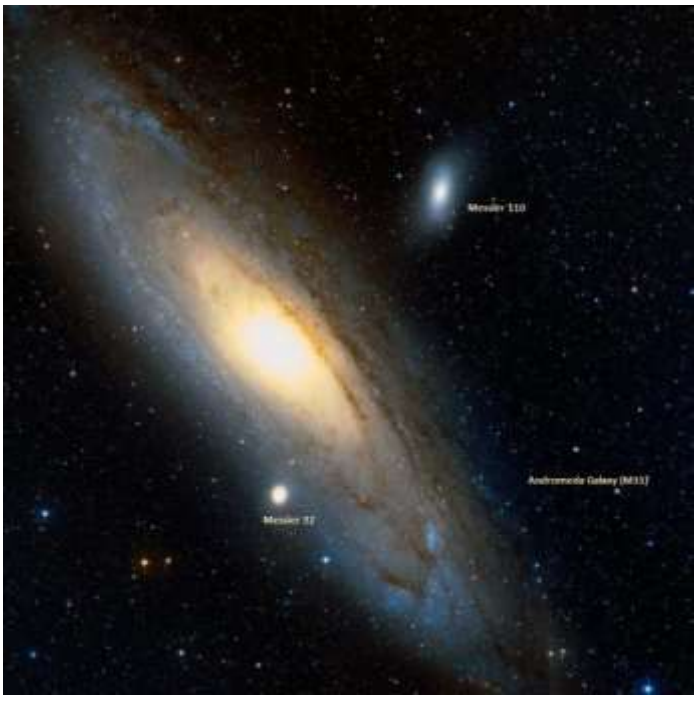
Messier 110 (NGC 205) is a satellite of the Andromeda Galaxy. It's a dwarf elliptical galaxy, a common type of galaxy often found in galaxy clusters and groups, and it contains about 10 billion stars. Like all dwarf ellipticals, it doesn't have the characteristic shape of galaxies like Andromeda or the Milky Way, with their vast, spiral arms. It has a smooth, featureless shape.

Dwarf ellipticals lack the blazing bright areas of active star formation that other galaxies display. In fact, astronomers think that they're too old to have any young stars at all. But M110 appears to be different.

This image of M 110 from the Hubble Space Telescope shows that the dwarf elliptical has some hot blue stars in its center. Those stars might shed some light on how dwarf ellipticals form, a question that astronomers have been thinking about for some time.

A star's color, temperature, mass, and age are all related. Blue stars are hotter than our yellow Sun, because they're more massive and burn fuel more quickly than a smaller star, like a car with a larger engine. To be blue, they have to have at least three times more mass than our Sun.

But because they burn their fuel more quickly, they also run out of it sooner. So the blue stars in the Hubble image of M 110 have to be younger than the yellow and red stars that make up the bulk of the galaxy's population.



Messier 31 (the Andromeda Galaxy), along with Messier 32 and Messier 110. M 110 is a satellite of the Andromeda Galaxy. Credit: Wikisky

The Sun is less massive, burns its fuel more slowly, and never reaches the same temperature as a blue star. The Sun will never be blue, (though it will eventually turn red) and will live longer than a blue star.

Dwarf ellipticals don't have the same stellar nurseries as other galaxy types, which are luminous regions dominated by the formation of hot blue stars. Because of that, they're considered dead. All of the stars are older, and either yellow or red. As those stars age, no new stars form to take their place.

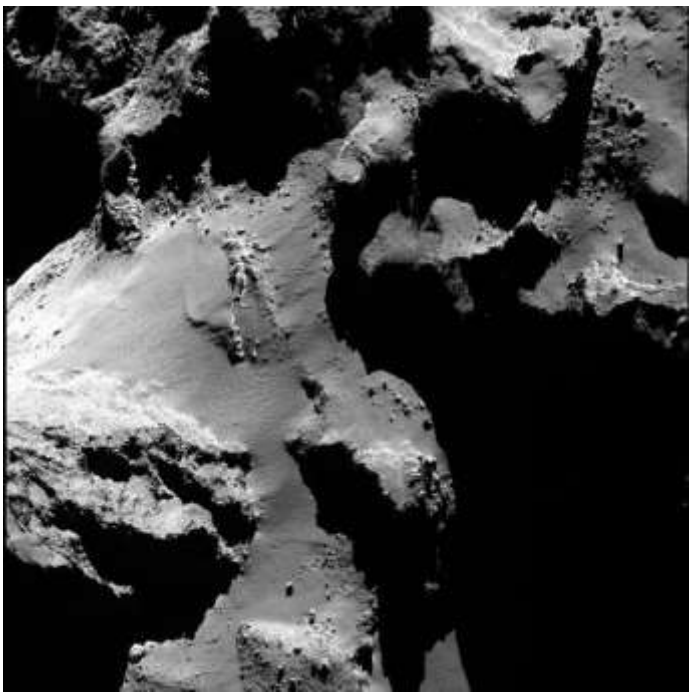
Because dwarf ellipticals usually contain no new stars, astronomers think they're nearing the end of their evolutionary life. That may be because black holes at their centers are gobbling up the gas necessary to form new stars. Or it could be because dwarf ellipticals are the result of collisions between other galaxies. Those collisions could strip away the gas that forms stars. But the discovery of young blue stars in M 110 means there may be more to dwarf ellipticals than we know. In fact, astronomers aren't certain that dwarf galaxies even have black holes.

The Andromeda galaxy with M 110 below and to the right. Image Credit: By Torben Hansen – https://www.flickr.com/photos/torbenh/6105409913, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=54367045

The Hubble image was taken in visible and near-infrared light with the Wide Field and Planetary Camera 2. M 110's center is near the lower right of the image, where the young blue stars are. Bright points are globular clusters contained in the galaxy, as well as individual stars. This Hubble image was part of an effort to understand globular clusters.

The image also shows clouds of gas and dust, which appear as blotches. A large cloud is visible in the middle of the image, and a small one is just above the galactic core.

Rosetta Saw Collapsing Cliffs and Other Changes on 67P During its Mission



It seems that comet 67P/Churyumov–Gerasimenko is not the stoic, unchanging Solar System traveller that it might seem to be. Scientists working through the vast warehouse of images from the Rosetta spacecraft have discovered there's lots going on on 67P. Among the activity are collapsing cliffs and bouncing boulders.

A Distant Asteroid Collision Gave Earthly Biodiversity An Ancient Boost

About 466 million years ago, there was an asteroid collision in the asteroid belt between Mars and Jupiter. The collision caused the breakup of a major asteroid, creating a shower of dust throughout the inner Solar System. That event is called the Ordovician Meteor Event, and its dust caused an ice age here on Earth.

That ice age contributed to an enormous boost in biodiversity on ancient Earth.

In recent decades, scientists have uncovered evidence showing how different events in space shaped life on Earth. The most well-known of these is the Chicxulub impact that brought the reign of the dinosaurs to an end some 66 million years ago. But there have been other events in space that affected life on Earth, including a supernova that exploded about 2.6 million years ago that may have wiped out large ocean animals, and another supernova that exploded about 41,000 years ago and that may have helped wipe out the mammoths.

But in this case, the asteroid-dust ice age may have helped life on Earth rather than hindered it.

Scientists have known about the Ordovician Meteor Event (OME) for some time now. They know it was an L-chondrite asteroid because they can see its dusty residue in Earth's stratified layers. In fact, the breakup of that 150 km. diameter ancient asteroid 467 million years ago still delivers almost a third of all the meteorites that strike Earth. That event was no trivial matter; it's the largest asteroid breakup that we know of in the last 3 billion years.

Something else happened on Earth about 466 million years ago: the mid-Ordovician Ice Age. The climate was homogeneous before that, the same from pole to pole. But when the ice age came, the seas froze at the poles and the equatorial regions were much warmer than the polar regions. The different climatic regions spurred greater evolution of species, bringing about a boom in biodiversity.

But linking the Ordovician Meteor Event to the mid-Ordovician ice age has been controversial.

According to a new study titled "An extraterrestrial trigger for the mid-Ordovician ice age: Dust from the breakup of the L-chondrite parent body" the causal link between the OME and the ice age is now much stronger. The study was published in the journal Science Advances.

The authors of the study come from a variety of institutions around the world, including Lund University in Sweden. Their work focuses on sea-floor sediment data that came from the time of the Ordovician Meteor Event. The authors say that after the OME, there was an increase of three to four orders of magnitude in fine-grained material falling to Earth.

Birger Schmitz next to the sea floor sediment in Kinnekulle (Photo: Philip R. Heck)

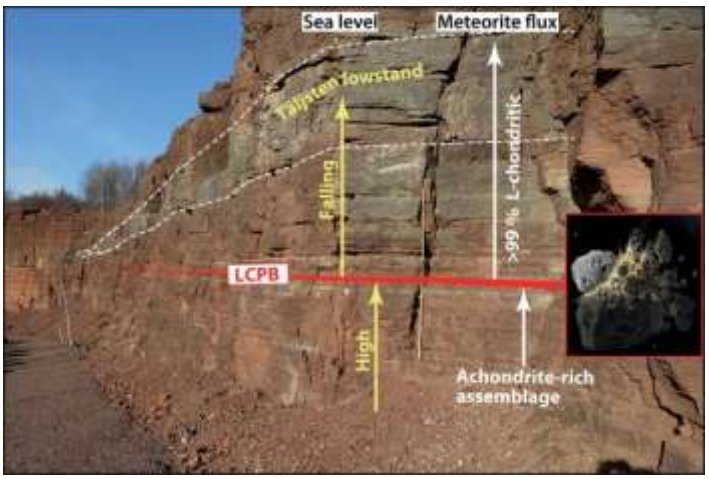
The amount of material falling to Earth had to have matched the amount blanketing the inner Solar System. "Extraordinary amounts of dust in the entire inner solar system during >2 Ma following the L-chondrite breakup cooled Earth and triggered Ordovician icehouse conditions, sea level fall, and major faunal turnovers related to the Great Ordovician Biodiversification Event," the paper says.

"Normally, Earth gains about 40,000 tons of extraterrestrial material every year," says Philipp Heck, a curator at the Field Museum, associate professor at the University of Chicago, and one of the paper's authors. "Imagine multiplying that by a factor of a thousand or ten thousand."

"Our hypothesis is that the large amounts of extraterrestrial dust over a time-frame of at least two million years played an important role in changing the climate on Earth, contributing to cooling," says Heck.

"Our results show for the first time that such dust, at times, has cooled Earth dramatically," says Birger Schmitz of Sweden's Lund University, the study's lead author and a research associate at the Field Museum. "Our studies can give a more detailed, empirical-based understanding of how this works, and this in turn can be used to evaluate if model simulations are realistic."

The scientists focused on 466 million year old sedimentary sea rocks from the same time as the OME. They looked for traces of space dust, then compared it to tiny micrometeorites from Antarctica for comparison. "We studied extraterrestrial matter, meteorites and micrometeorites, in the sedimentary record of Earth, meaning rocks that were once sea floor," says Heck. "And then we extracted the extraterrestrial matter to discover what it was and where it came from."



This is an image of stratigraphic levels in ancient seafloor rocks in southern Sweden, one of the locations where the authors studied the rock. The red line marks the time of the Ordovician Meteor Event. At that same line, analysis of the rock shows an abundance of L-Chondrite grains that drifted down to Earth after the OME. The nature of the limestone changes, too, indicating that it formed during time of lower sea levels, as the poles froze and the oceans dropped. Image Credit: Birger Schmitz, Lund University

They used acid to eat away the rock, leaving only the space dust behind. Then they analyzed the chemical makeup of the dust. They looked for evidence of extraterrestrial origin in the form of He3, an isotope of helium that comes from the Sun but is absent on Earth. Finding these isotopes and other rare minerals that come from space, like chromites, prove the dust is extraterrestrial in origin.

The authors of this study are the first to show that the mid-Ordovician ice age is linked to the Ordovician Meteor Event. “The timing appears to be perfect,” he says. The dust from the OME would have blocked out sunlight, triggering global cooling and the ice age.

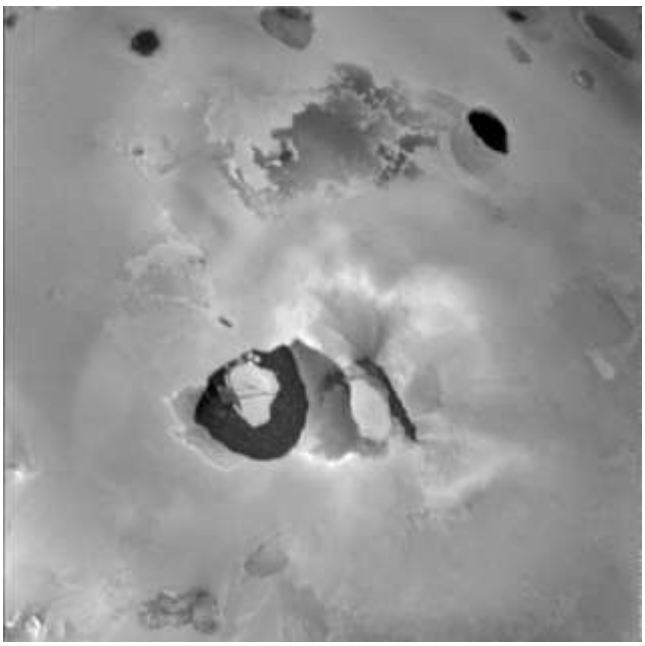
But this ice age wasn’t catastrophic for life on Earth. Quite the opposite. All this dust settle to Earth over a two million year period, meaning the cooling was gradual, not catastrophic. As a result, life had a chance to adapt. That adaptation led to a boom in new life forms, as species adapted to new climate conditions. That boom is called the Great Ordovician Biodiversification Event (GOBE.)

Heck is quick to caution people against drawing false conclusions. Just because this type of climate change led to greater biodiversity, it doesn’t mean we can take climate change lightly.

“In the global cooling we studied, we’re talking about timescales of millions of years,” said Heck. “It’s very different from the climate change caused by the meteorite 65 million years ago that killed the dinosaurs, and it’s different from the global warming today– this global cooling was a gentle nudge. There was less stress.”

If this gradual cooling sounds like a solution we could implement to limit global climate change, Heck throws cold water on that idea, too. “Geoengineering proposals should be evaluated very critically and very carefully, because if something goes wrong, things could become worse than before.”

Io’s Largest Volcano, Loki, Erupts Every 500 Days. Any Day Now, It’ll Erupt Again.



Jupiter’s moon Io is in stark contrast to the other three Galilean moons. While Callisto, Ganymede, and Europa all appear to have subsurface oceans, Io is a volcanic world, covered with more than 400 active volcanoes. In fact, Io is the most volcanically active body in the Solar System.

Io’s largest volcano is named Loki, after a God in Norse mythology. It’s the most active and most powerful volcano in the Solar System. Since 1979, we’ve known that it’s active and that it’s both continuous and variable. And since 2002, thanks to a research paper in the Geophysical Research Letters, we’ve known that it erupts regularly.

Metallic Asteroids Might Have Had Volcanoes Erupting Molten Iron. That’s So Metal

Remember the asteroid Psyche? It’s the largest known asteroid in the asteroid belt between Mars and Jupiter. It’s been in the news because of its unusual properties, and because NASA plans to launch a mission to Psyche in 2022.

Psyche, aka 16 Psyche, is unusual because it’s quite different from other asteroids. Psyche appears to be the remnant, exposed nickel-iron core of an early planet. Because of that, Psyche is a building block left over from the early Solar System, when planets were still forming. It’s like a planet without a crust.

But Psyche has another weird characteristic that scientists are keen to study: it’s much less dense than it should be, given the fact that it’s largely composed of iron and nickel.

A new theory tries to explain how this iron-nickel asteroid, with a metallic surface, could have a density far lower than it should.

Psyche is a class of asteroid called a pallasite, after Peter Pallas, a German who studied the Krasnoyarsk meteorite in 1722. That rock fell to Earth near the Russian city of Krasnoyarsk, and was the first pallasite ever found. Those were back in the days when nobody believed meteorites even came from space. It weighed about 700 kg (1500 lb) and is one of only 61 pallasites ever identified.

A slice of the Krasnoyarsk meteorite on display at the American Museum of Natural History. Image Credit: By Jon Taylor – Flickr: Krasnojarsk AMNH, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=16096581

While most asteroids consist mostly of rocky rubble, pallasites like Psyche are enigmatic, composed mostly of iron and nickel with olivine crystals entrained in it. Scientists think they formed when planetesimals collided, stripping away outer material and leaving the inner metallic cores. The asteroid then cooled from the outside in.

As it cooled, an alloy of residual melted pockets of iron, nickel and lighter elements like sulfur, might have erupted to the surface through fluid-filled cracks called dikes, creating virtual volcanoes of molten metal. That material would have created a coating on the topmost, rocky layer. That process is called ferrovolcanism.

Psyche may owe its lower-than-expected density to ferrovolcanism. Since Psyche, like other pallasites, is a mixture of core and mantle material, it may have experienced this type of mixing. The pockets of liquid metal mixed with sulfur are lower density than surrounding material, forming dikes that allowed ferrovolcanism to happen.

This diagram depicts a theoretical phenomenon called ferrovolcanism, where metallic asteroids erupt molten iron in a class of asteroids called pallasites. The ferrovolcanism might result when pockets of melted alloy rise to the surface. An upcoming NASA space mission to the asteroid Psyche may allow scientists to confirm their theory. (Purdue University image/James Keane)

"Our calculations suggest that ferrovolcanic eruptions may be possible for small, metal-rich bodies, especially for sulfur-rich melts and bodies with mantles thinner than about 35 kilometers or bodies where the mantle has been locally thinned by large impact craters," said co-author of the paper, Brandon C. Johnson, associate professor of earth, atmospheric and planetary sciences at Purdue University.

Since Psyche is one of the most massive bodies in the asteroid belt, at about 200 km (120 mi) in diameter, ferrovolcanism may explain its low-density, while also explaining the surface metallicity it shows in radar and other evidence.

"Ferrovolcanism may have transported core material to the surface, causing the radar detections of metal," Johnson said.

Psyche's density is so low that it's about half that of an iron meteorite. It's also the largest metallic asteroid in the Solar System, that we know of. If its low density is due to ferrovolcanism, as the authors of the paper say it might be, it'll be up to NASA's mission to Psyche to figure it out.

That mission is due to launch in 2022. It'll be the first spacecraft to visit a metallic asteroid. Since ferrovolcanism is just a proposed model at this point, it'll be up to that spacecraft to confirm its role. The mission to Psyche might also answer questions about the role metallic asteroids played in the development of the Solar System.

The paper outlining this work is published in the journal Nature Astronomy. It's titled "Ferrovolcanism on metal worlds and the origin of pallasites." The authors are Brandon C. Johnson, Michael M. Sori & Alexander J. Evans.

India has Located the Vikram Lander, But it's Still not Communicating With Home

On Sunday (Sept. 8th), the Indian Space Research Organization (ISRO) announced that they had located *Vikram*, the lander element of their *Chandrayaan-2* mission. The search began almost immediately after the space agency lost contact with the robotic spacecraft, which occurred moments before it set down on the lunar surface (on Friday, Sept. 6th).

The location of the lander was confirmed by the *Chandrayaan-2* orbiter, which managed to spot the lander using its high-resolution thermal camera. However, the ISRO has not re-established communications with the lander yet, which means that they are uncertain of whether or not the lander (or the *Pragyan* rover, which it carries) survived the descent.

Said Kailasavadivoo Sivan, the chairperson of the Indian Space Research Organization (ISRO), in a statement to Asian News International (ANI):

"We have the location of the Lander Vikram on [the] lunar surface and [the] orbiter has clicked a thermal image of [the] Lander. We are trying to establish contact. It will be communicating soon."

He also added that it was "premature to say anything" for certain. This statement was echoed by an official update posted on the ISRO's *Chandrayaan-2* mission page:

"Vikram lander has been located by the orbiter of Chandrayaan-2, but no communication with it yet. All possible efforts are being made to establish communication with lander."

Indications that there might be a problem with the landing began once Vikram reached an altitude of 2.1 km (1.3 mi) from the lunar surface. At this point, the lander began to deviate from its intended trajectory, which was followed by a loss

of communications just as mission controllers expected to receive touchdown confirmation.

The ISRO's Mission Control Center in Bengaluru, India, immediately indicated that they would be analyzing data from the orbiter to determine what happened. Naturally, there were many concerns that *Vikram* had failed to make a soft landing on the surface and actually crashed. As of this past weekend, the ISRO confirmed that this was likely to be the case.

"Yes, we have located the lander on the lunar surface," said Sivan to the Times of India. "It must have been a hard landing."

Attempts to restore communications are ongoing, but the ISRO is likely to cease these efforts by Sept. 21st, which is when the lander was originally expected to operate until. Mission planners intended for the lander to set down in the southern polar region, deploy the *Pragryan* rover, and remain operational for a single lunar day (the equivalent of about 14 Earth days).

At this point, many have their fingers crossed that the ISRO will be able to snatch success from the jaws of failure. If contact can be re-established, India will be the fourth nation in the world to land an exploration craft on the Moon (though the qualifier that it was a "soft landing" will have to be dropped).

However, even if contact cannot be restored with the lander, the mission is hardly a write-off. The *Chandrayaan-2* orbiter is still operational and will remain in orbit around the Moon for the next seven years. Carrying on in the tradition of its predecessor, it will study the lunar surface using its suite of eight scientific instruments and the data will inform future ISRO missions.

India remains a growing power in space, and setbacks are an unfortunate but inevitable part of the process of space exploration.

Below:

Some of the purple sunset skies seen from Spain while I was there mid month,

Above: The purple shade from Wiltshire

Andy

E Mails Viewings Logs and Images from Members.

Hi Andy,

Here are my submissions for the WAS October 2019 Newsletter.

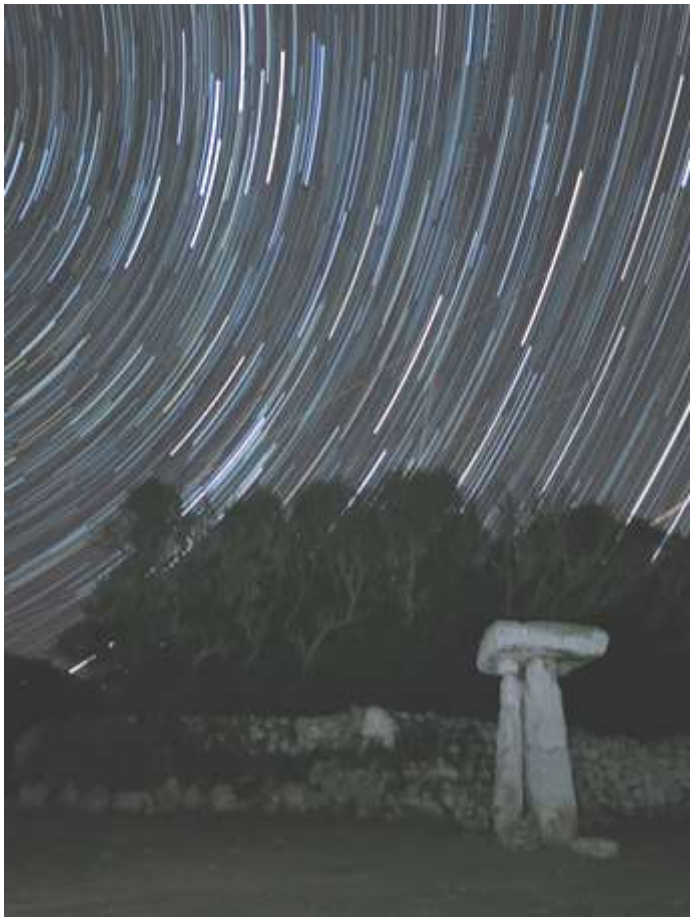
First a view of the southern Milky Way from the coast of Menorca on 18/09/2019. Jupiter and Saturn are in the frame. I took several images but this was the only one that I could not see any aircraft trails.I was trying to get some of the other scenery in the frame but as I was only 6 foot or so from a cliff edge in the dark my movement was somewhat restricted! Canon G16 28mm, F1.8, ISO 1250, 15 sec.

Second a star trail above the Taula at the Poblat Talaiotic de Torretrencada on 24/09/2019. Taula are T shaped standing stone constructions dating from the Bronze/Iron Ages. They are believed to have been used for ritual purposes. There are seven still upright on Menorca but most cannot be accessed at night. Fortunately, this one can be although I am surprised the site is not better protected. Although the biting insects where quite ferocious as my wife can testify as she ended up covered in bites! Canon G16, 28mm, 120 images at F1.8, ISO 400, 30 sec.

Third a view of the Taula looking north east with the Milky Way and Cassiopiea and Andromeda. Canon G16, 28mm, F1.8, ISO 800, 15 sec.

Clear Skies,

John



Editor note.

I remember visiting the Taula on Menorca many years ago. Excellent to see night views John.

Andy's imaging.

I went to Spain at full Moon so did not use the telescopes, I had other duties to do.

But by the 20th September the Moon was rising late enough to get out and use my dome for the first time since early summer. Trees need trimming but was able to get some telescope time in chasing clusters.

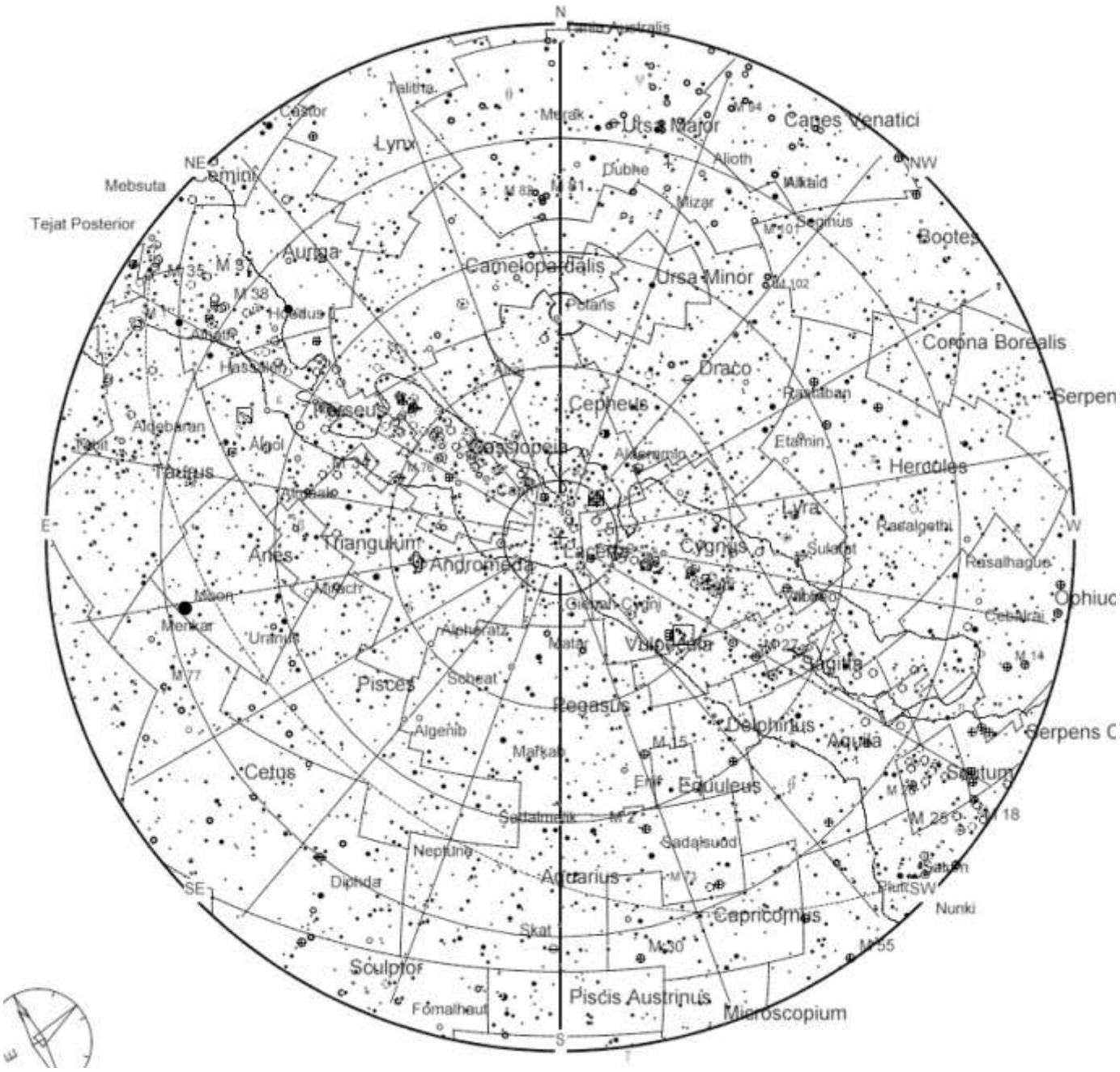
M11 the Wild Duck.

M15 Globular.

M2

Also pick up the eastern part of the Veil nebula, the remains from a nova explosion from about 8000 years ago.

WHATS UP, October 2019



October 8 - **Draconids Meteor Shower.** The Draconids is a minor meteor shower producing only about 10 meteors per hour. It is produced by dust grains left behind by comet 21P Giacobini-Zinner, which was first discovered in 1900. The Draconids is an unusual shower in that the best viewing is in the early evening instead of early morning like most other showers. The shower runs annually from October 6-10 and peaks this year on the the night of the 8th. The first quarter moon will set shortly after midnight leaving fairly dark skies for observing. Best viewing will be in the early evening from a dark location far away from city lights. Meteors will radiate from the constellation Draco, but can appear anywhere in the sky.

October 13 - **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 21:09 UTC. This full moon was known by early Native American tribes as the Full Hunters Moon because at this time of year the leaves are falling and the game is fat and ready to hunt. This moon has also been known as the Travel Moon and the Blood Moon.

October 20 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 24.6 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

October 21, 22 - **Orionids Meteor Shower.** The Orionids is an average shower producing up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley, which has been known and observed since ancient times. The shower runs annually from October 2 to November 7. It peaks this year on the night of October 21 and the morning of October 22. The second quarter moon will block some of the fainter meteors this year, but the Orionids tend to be fairly bright so it could still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Orion, but can appear anywhere in the sky.

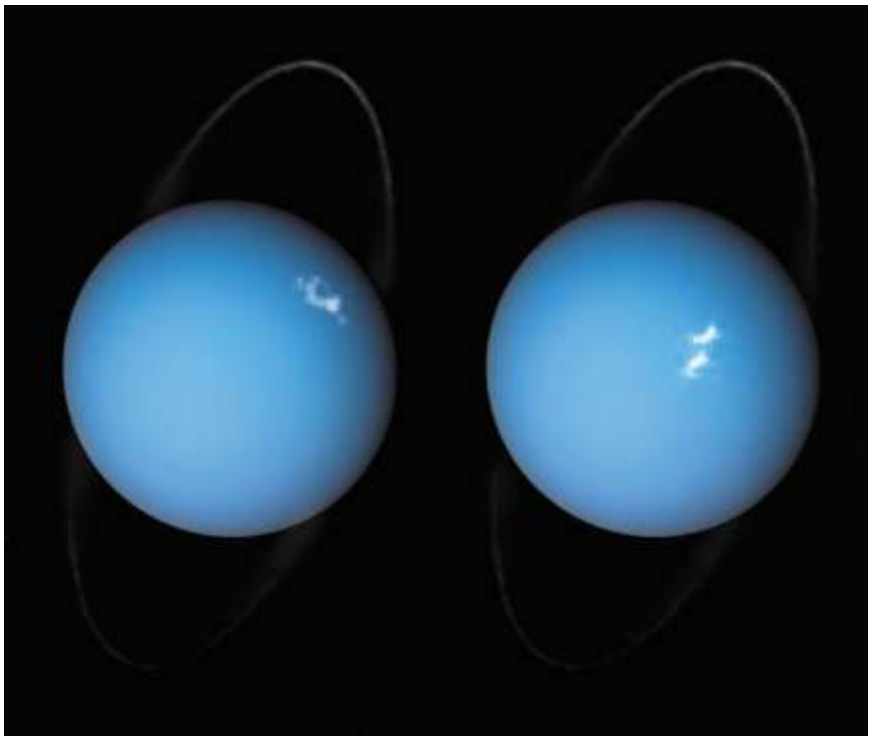
October 27 - **Uranus at Opposition.** The blue-green planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Find Strange Uranus in Aries

David Prosper

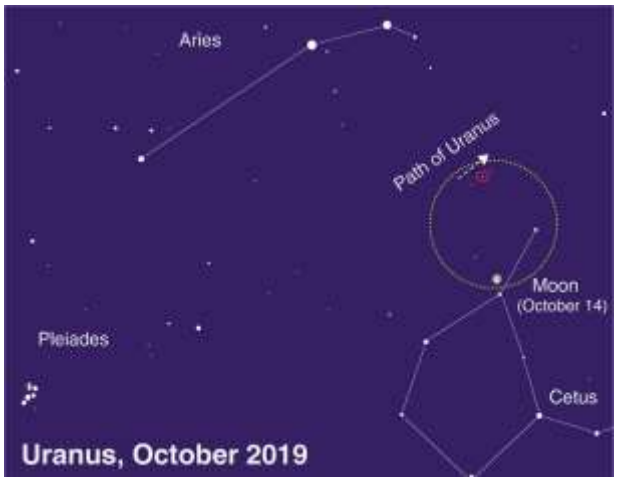
Most of the planets in our solar system are bright and easily spotted in our night skies. The exceptions are the ice giant planets: Uranus and Neptune. These worlds are so distant and dim that binoculars or telescopes are almost always needed to see them. A great time to search for Uranus is during its opposition on October 28, since the planet is up almost the entire night and at its brightest for the year.



Caption: The path of Uranus in October is indicated by an arrow; its position on October 14 is circled. The wide dashed circle approximates the field of view from binoculars or a finderscope. Image created with assistance from Stellarium.

Search for Uranus in the space beneath the stars of Aries the Ram and above Cetus the Whale. These constellations are found west of more prominent Taurus the Bull and Pleiades star cluster. You can also use the Moon as a guide! Uranus will be just a few degrees north of the Moon the night of October 14, close enough to fit both objects into the same binocular field of view. However, it will be much easier to see dim Uranus by moving the bright Moon just out of sight. If you're using a telescope, zoom in as much as possible once you find Uranus; 100x magnification and greater will reveal its small greenish disc, while background stars will remain points.

Try this observing trick from a dark sky location. Find Uranus with your telescope or binoculars, then look with your unaided eyes at the patch of sky where your equipment is aimed. Do you see a faint star where Uranus should be? That's not a star; you're actually seeing Uranus with your naked eye! The ice giant is just bright enough near opposition - magnitude 5.7 - to be visible to observers under clear dark skies. It's easier to see this ghostly planet unaided after first using an instrument to spot it, sort of like "training wheels" for your eyes. Try this technique with other objects as you observe, and you'll be amazed at what your eyes can pick out.

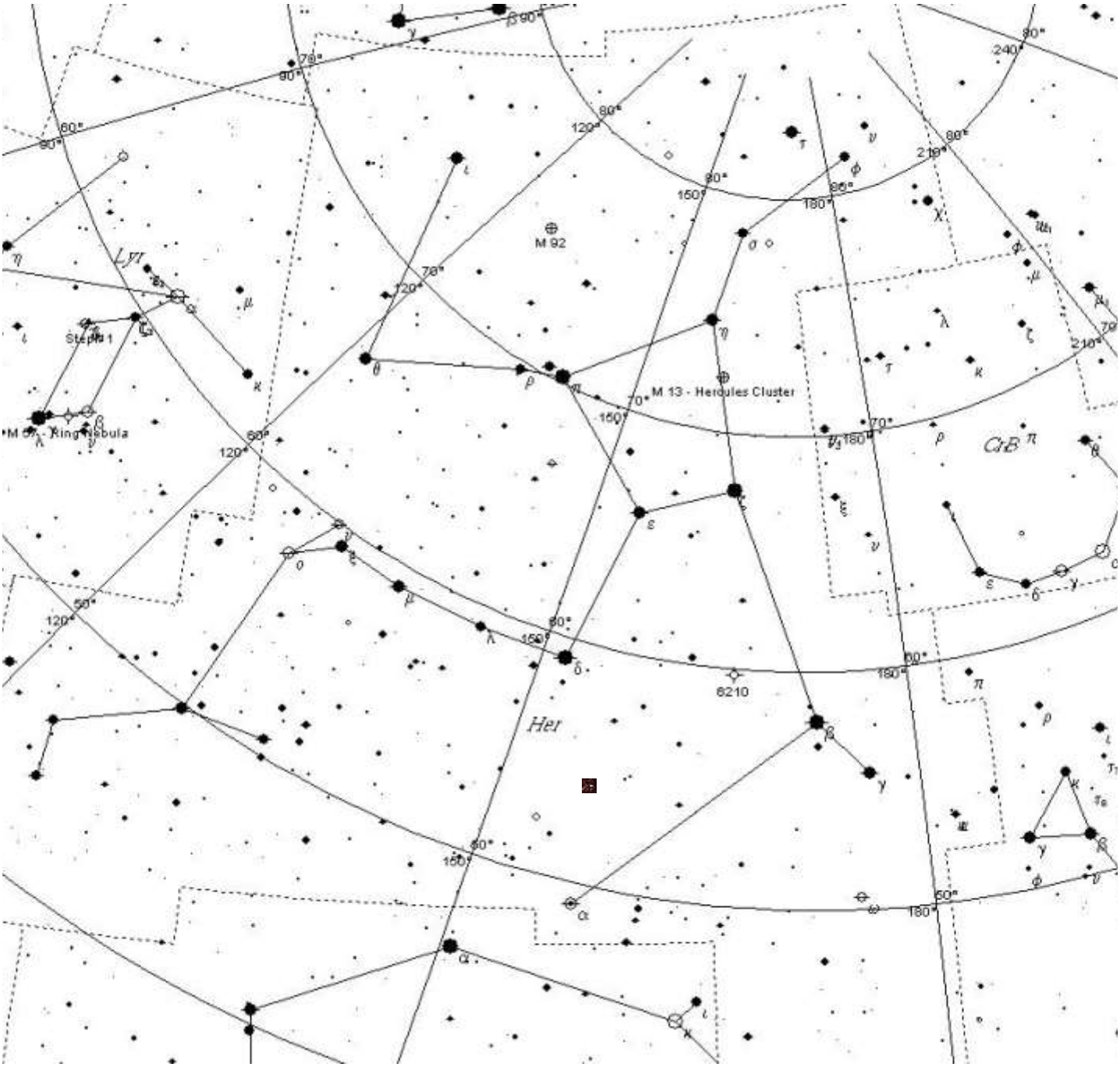


Caption: Composite images taken of Uranus in 2012 and 2014 by the Hubble Space Telescope, showcasing its rings and auroras. More at bit.ly/uranusauroras Credit: ESA/Hubble & NASA, L. Lamy / Observatoire de Paris

By the way, you've spotted the first planet discovered in the modern era! William Herschel discovered Uranus via telescope in 1781, and Johan Bode confirmed its status as a planet two years later. NASA's Voyager 2 is the only spacecraft to visit this strange world, with a brief flyby in 1986. It revealed a strange, severely tilted planetary system possessing faint dark rings, dozens of moons, and eerily featureless cloud tops. Subsequent observations of Uranus from powerful telescopes like Hubble and Keck showed its blank face was temporary, as powerful storms were spotted, caused by dramatic seasonal changes during its 84-year orbit. Uranus's wildly variable seasons result from a massive collision billions of years ago that tipped the planet to its side.

Discover more about NASA's current and future missions of exploration of the distant solar system and beyond at nasa.gov

CONSTELLATIONS OF THE MONTH: Hercules



Transit Date of principal star:
10 June

Unless you are an avid stargazer, you might not be sure just where to look for Hercules. While the fifth largest constellation, it isn't very obvious.

And yet Hercules boasts one of the finest collection of binary stars, and two Messier objects as well.

> We will make a fine distinction here: the constellation name is *Hercules,* while the Greek hero is *Heracles*.

Heracles was named after the greatest of Greek goddesses, Hera. Her name means "Lady" and she was the daughter of Cronus, and sister of Zeus (they were twins). Zeus later changed into a cuckoo and seduced his sister (he had that kind of reputation), and the two were married.

Hera became the Queen of the Heavens: goddess of childbirth, marriage, and of women, she was the most widely beloved of goddesses in antiquity. It would only be natural that the greatest of Greek heroes would be named after her: Heracles means "the glory (or honour) of Hera".

Although named after Hera, Heracles didn't have her immediate respect. Heracles was the son of Zeus and a mortal woman (Alcmene). Hera resented Zeus' philandering nature, and tried to have the child killed. She sent two monstrous snakes to his crib, but the infant strangled them both with his pudgy little hands.

Heracles became a favourite with the gods. Apollo made his bow and arrows; Athene gave him a magnificent robe; Hermes provided him with a sword, and Castor (the greatest warrior) taught him how to use it. Hephaestus, the smithy of the gods, made a golden breastplate for Heracles. Thus armed and protected, Heracles paraded through Greek mythology, performing eight heroic deeds and the Twelve Labours.

In fact, the very word "hero" has links with the names Hera and Heracles. The Romans would change his name to Hercules (and hers to Juno, and Zeus to Jupiter).

> "Hercules" came to Italy in his tenth labour. He would later be given credit for abolishing human sacrifice in the land.

The constellation was originally represented as a kneeling man, with a foot on the neighbouring dragon (Draco). Some star names reflect this earlier association.

Hercules is a sprawling constellation just to the west of Lyra. From Vega (alpha Lyrae) swing to the west-southwest eight degrees. This is *theta Herculis*, a 3.86 magnitude star - which is about typical brightness for the main stars of this constellation.

The principal stars are found farther south. Star hop from theta over to pi Herculis, and then to the southwest (about the same distance from pi Herculis to Vega) is *beta Herculis*, which is actually the brightest star in the constellation.

Now look southeast and you will come across alpha Ophiuchi (Ras Alhague), at 2.1 magnitude, the brightest star of the region. Alpha Herculis is northwest of this star.

Alpha Herculis is better known as *Ras Algethi: The kneeler's head.* It is estimated to be from 430 to about 650 light years. Some authorities believe the star to be as large as 400 solar diameters.

This is a fine double: a red (or orange) supergiant and a blue-green giant (see below). The primary is also an irregular variable (see below).

Double stars in Hercules:

Hercules has several binaries with contrasting colours, as well as several close binaries, challenging those with larger telescopes.

Alpha Herculis is a visual binary with a very long period, something like 3600 years. 3.2, 5.4; PA 104, separation 4.6".

Zeta Herculis is a rapid binary with colour contrast, a yellow primary and red companion with a period of 34.45 years: 2.9, 5.5. The 2000 values: PA 12º degrees, and the separation 0.7".

Kappa Herculis is an easily resolved binary: 5.3, 6.5; PA 12 degrees, separation 28.4".

Rho Herculis: two white stars which make a lovely double. 4.6, 5.6; PA 326, separation 4.1".

95 Herculis is a very attractive double with contrasting colours, often described as gold and silver (although you may disagree): 5.0, 5.1; PA 258 degrees, separation 6.3".

99 Herculis is a very close rapid binary: 5.1, 8.4; currently the PA is 92 degrees and the separation 0.3".

100 Herculis is another gorgeous binary of two equal white stars easily resolved. 5.9; 5.9; PA 183 degrees, separation 14.2"

Struve 2319. This is a very beautiful binary of two rather faint stars: 7.2, 7.6; PA 191 degrees, separation 5.4".

Variable stars in Hercules:

Alpha Herculis is an irregular variable with a range from 2.7 to 4.0, with a period of roughly three months.

S Herculis is the brightest long-period variable in Hercules, with a visual magnitude range of 6.4-13.8 every 318.14 days. The maximum for the year 2000 should occur in mid July.

Deep Sky Objects in Hercules:

There are two Messier objects in Hercules: M13 and M92.

M13 (NGC 6205) is a spectacular globular cluster sometimes known as "The Hercules Cluster". It is universally acclaimed as the best globular in the northern hemisphere.

This is a very compact cluster of over a million stars. It is also very old - at an estimated age of ten billion years. It's around 25,000-30,000 light years away.

M13 lies on a line between eta Herculis and zeta Herculis, due west of pi Herculis.

Almost seventy years ago, radio was exciting. People were still adjusting to its instantaneous connection with events from around the world as soon as they happened. Therefore, many listeners believed the dramatic presentation, presented as news during the radio play, was real. The broadcast has been followed by countless books, television shows and motion pictures which, combined, helped the notion of intelligent alien life to take firm roots in our culture. Science was also invaded by the possibility of extraterrestrial beings. In 1974, a carefully crafted message was transmitted from the world's largest radio telescope and directed towards stars in M13, pictured here, in hopes someone or something would be listening.

M13 is one of the most prominent and best-known globular clusters in the night sky. It is the brightest that can be easily seen with a small telescope or pair of binoculars from most places in the northern hemisphere. Located in the constellation of Hercules, M13 is visible this time of year. It is twenty thousand lights years from Earth and its 100,000 stars form a ball so immense that it takes light 150 years to travel from one side to the other. The age of M13 is estimated at about 14 billion years.

The 1974 three minute message to M13 was beamed into space from the Arecibo Radio Telescope, in Puerto Rico, and was spearheaded by Dr. Frank Drake, a leading SETI proponent and colleague of the late Carl Sagan. A much longer three-hour message to other carefully selected stars was subsequently transmitted in 2001 from a radio telescope in the Ukraine. Of course, if anyone is around when our 1974 mes-

sage arrives at a hypothetical planet orbiting a star in M13, their response will not return here until fifty thousand years have transpired.

History of Observation:

This awesome globular cluster was originally discovered by Johann Elert Bode on December 27, 1777 who wrote:

"A nebula. More or less round with pale glow. On this occasion, I also want to announce that on December 27, 1777 *I have discovered a new nebula in Hercules, not known to me, southwest below the star s in his foot, which shows up in a mostly round figure with a pale glimmer of light. Its longitude is about 11 deg [Sgr] [251 d] and its latitude 66d north.*Together *with two small [faint] stars, which don't occur at Flamstead, it appears in the reversing telescope as shown in fig k (in the following volume)."*

Charles Messier would be the next to encounter it on March 18, 1781. In his notes he writes:

"Nebula, fine, distinct, and very bright, between the knee and the left leg of Hercules, it can be seen very well in a telescope of one foot [FL]. It contains no star; the center is clear and brilliant, surrounded by nebulosity and [it] resembles the nucleus of a large Comet: its brightness, its size, approach much that of the nebula which is in the girdle of Hercules. See No. 13 of this Catalog: its position has been determined, by direct comparison with the star Sigma Herculis, fourth magnitude: the nebula and the star are on the same parallel. (diam. 5')"

Messier 92 by the Hubble Space Telescope. Credit: ESA & NASA

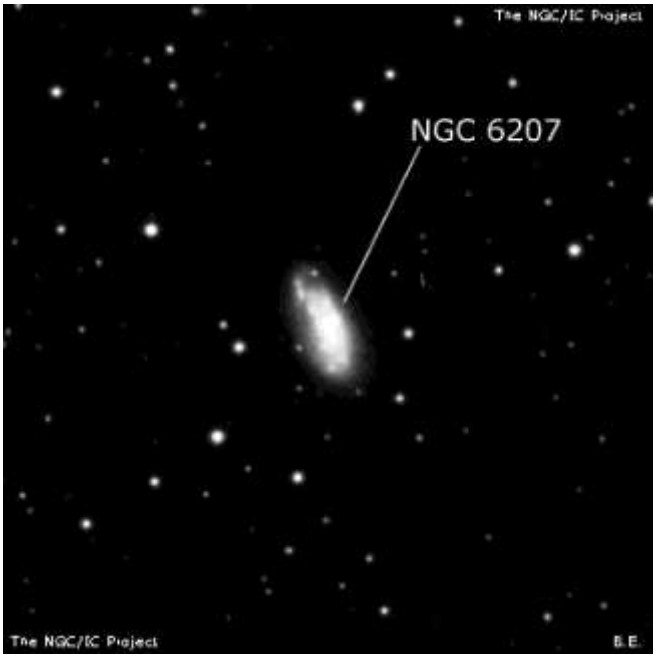
Sir William Herschel would be the first to resolve it into stars, but it was Admiral Smyth who gave M92 the true attention it deserved:

"A globular cluster of minute stars, preceding the right leg of Hercules. This object is large, bright, and resolvable, with a very luminous centre; and, under the best vision, has irregular streamy edges. It is immediately preceded by a 12th-magnitude star, distinct from the outliers, and there are several other stars in the field, of which the brightest is of the 7th magnitude in the nf [north following, NE], with a Delta AR = 28s. Messier, who enrolled it in 1781, remarks that "it is easily seen with a telescope of one foot [FL];" and it really demands very little optical aid to render it visible. Messier's own instrument did not, it seems, resolve it, for he compares the shining centre, with its attendants, to the nucleus of a comet surrounded by nebulous matter; but of course, it rose into a brilliant cluster, of 7' or 8' in diameter, before the reflectors of Sir W. Herschel in 1783. The mean place was obtained by carefully differentiating the cluster with Eta Herculis, from which it bears north-by -east, 1deg 1/2 distant; bearing to the north of Alpha Herculis, and west of Wega."

M92 (NGC 6341) is also a globular cluster, located nine degrees northeast of M13, and six degrees directly north of pi Herculis.

Globular cluster M92 is one of the original discoveries of Johann Elert Bode, who found it on December 27, 1777. Charles Messier independently rediscovered it and cataloged it on March 18, 1781, the same day as he cataloged another 8 objects, all of them Virgo Cluster galaxies (M84-M91). It was William Herschel who first resolved it into stars in 1783.

M92 is also very striking and worthy of consideration, even if considerably overshadowed by M13.



ISS PASSES For October 2019 From Heavens Above website maintained by Chris Peat

Date	Brightness (mag)	Start			Highest point			End		
		Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
01 Oct	-3.8	19:32:49	10°	W	19:36:09	86°	N	19:39:05	13°	E
01 Oct	-2.5	21:09:35	10°	W	21:11:58	37°	WSW	21:11:58	37°	WSW
02 Oct	-3.6	20:21:03	10°	W	20:24:22	62°	SSW	20:25:20	40°	SE
03 Oct	-3.7	19:32:33	10°	W	19:35:53	77°	SSW	19:38:42	14°	ESE
03 Oct	-1.8	21:09:29	10°	W	21:11:36	24°	SW	21:11:36	24°	SW
04 Oct	-2.7	20:20:50	10°	W	20:23:57	36°	SSW	20:25:01	28°	SSE
05 Oct	-3.1	19:32:16	10°	W	19:35:30	49°	SSW	19:38:29	12°	SE
05 Oct	-1.1	21:09:58	10°	WSW	21:11:23	13°	SW	21:11:23	13°	SW
06 Oct	-1.5	20:20:52	10°	W	20:23:19	19°	SW	20:24:56	14°	S
07 Oct	-2.0	19:32:03	10°	W	19:34:56	27°	SSW	19:37:49	10°	SSE
09 Oct	-0.9	19:32:20	10°	WSW	19:34:12	14°	SW	19:36:02	10°	S
25 Oct	-0.9	06:34:44	10°	S	06:36:44	15°	SE	06:38:43	10°	ESE
27 Oct	-1.9	05:32:39	10°	SSW	05:35:36	28°	SSE	05:38:32	10°	E
28 Oct	-1.5	04:45:41	16°	S	04:46:59	20°	SE	04:49:32	10°	E
29 Oct	-0.7	03:59:14	13°	ESE	03:59:14	13°	ESE	04:00:12	10°	ESE
29 Oct	-3.1	05:32:08	17°	SW	05:34:33	50°	SSE	05:37:50	10°	E
30 Oct	-2.7	04:45:35	36°	SSE	04:45:50	37°	SSE	04:48:59	10°	E
30 Oct	-3.7	06:19:01	10°	W	06:22:24	89°	S	06:25:47	10°	E
31 Oct	-0.9	03:58:56	17°	ESE	03:58:56	17°	ESE	04:00:03	10°	E
31 Oct	-3.7	05:31:49	26°	WSW	05:33:35	78°	SSE	05:36:58	10°	E
01 Nov	-3.3	04:45:05	59°	SE	04:45:05	59°	SE	04:48:08	10°	E
01 Nov	-3.7	06:18:07	10°	W	06:21:30	85°	N	06:24:53	10°	E
02 Nov	-0.8	03:58:18	17°	E	03:58:18	17°	E	03:59:17	10°	E
02 Nov	-3.8	05:31:11	31°	W	05:32:39	86°	N	05:36:02	10°	E
03 Nov	-3.2	04:44:22	59°	E	04:44:22	59°	E	04:47:10	10°	E
03 Nov	-3.7	06:17:15	10°	W	06:20:32	83°	SSW	06:23:54	10°	ESE
04 Nov	-0.7	03:57:31	16°	E	03:57:31	16°	E	03:58:19	10°	E
04 Nov	-3.8	05:30:24	35°	W	05:31:41	88°	N	05:35:04	10°	E
05 Nov	-3.0	04:43:32	52°	E	04:43:32	52°	E	04:46:11	10°	E
05 Nov	-3.4	06:16:25	12°	W	06:19:29	56°	SSW	06:22:47	10°	ESE
06 Nov	-0.6	03:56:40	15°	E	03:56:40	15°	E	03:57:17	10°	E
06 Nov	-3.8	05:29:33	39°	W	05:30:39	72°	SSW	05:33:59	10°	ESE
07 Nov	-2.7	04:42:42	45°	ESE	04:42:42	45°	ESE	04:45:08	10°	ESE
07 Nov	-2.6	06:15:35	12°	W	06:18:16	32°	SSW	06:21:18	10°	SE
08 Nov	-0.4	03:55:53	12°	E	03:55:53	12°	E	03:56:14	10°	E
08 Nov	-3.2	05:28:45	38°	WSW	05:29:28	45°	SSW	05:32:42	10°	SE
09 Nov	-2.1	04:41:58	31°	SE	04:41:58	31°	SE	04:43:56	10°	ESE
09 Nov	-1.8	06:14:51	11°	WSW	06:16:52	17°	SW	06:19:09	10°	S
10 Nov	-2.4	05:28:07	25°	SSW	05:28:07	25°	SSW	05:30:56	10°	SSE
11 Nov	-1.3	04:41:26	17°	SSE	04:41:26	17°	SSE	04:42:25	10°	SE
12 Nov	-1.2	05:27:42	11°	SSW	05:27:42	11°	SSW	05:28:09	10°	SSW

END IMAGES, OBSERVING AND OUTREACH

I tested a new small highly mobile tracking mount in September. The MoveShootMove tracker is made in China and on its own is a small 3" x 3" x 1.5" box, but you mount on a good tripod with a tripod mount to point at the north star using an attachable green point laser, then a ball joint on the top for your camera. While they only recommend wide angle imaging it took a 100mm short telephoto for a couple of minutes exposure, I could go higher judging by the results.

Here is a 2 minute shot of the Milky Way and Silbury Hill plus traffic, to the right is Jupiter, and above left the other side of the Milky Way is Saturn/ Some patches of light from Devizes and Pewsey give a clue to the slight mist in the air, but kept the lens clear by using a hand warmer (that can also charge the tracking unit).

Nikon D810a and 20mm lens. These are heavy cameras and lenses so I can thoroughly recommend the unit with lighter gear (Canon, Sony, Pentax, Olympus).

About £230 all in with green pointer and a ball joint camera mount. Andy

Wiltshire Astronomical Society	**Observing Sessions 2018 – 2019**	**And 2019-2020**
Date	**Moon Phase (%)**	**Moonrise**
2019		
25th October		
22nd December		

OUTREACH

Evenings now too light for school link ins.

October 4th/11th Queen's Crescent School Astronomy Evening. Help required please. Possible viewing, but meteors, rocket models, books and equipment on show while I give some talks.

How about a Milky Way photo session? End of July will be ideal. Site to be arranged.