NWASNEWS

Volume24, Issue 2

October 2018

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies and Salisbury Plain Observing Group

Crossing the T's and Dotting the I's.

Thankyou members for coming to agreements that mean we can go forward with our GDPR compliance. So now we can collect your subs for the year.

The only records kept with names and addresses will be with our treasurer but no bank contact details are ever kept. A note is made of payments made as subs and also a book (not copied) is kept to keep accounts with attendees and moneys taken.

Any e-mail lists are kept separately for observing and general distribution of newsletters etc. These records only hold the email names given so could not be used to gather further information. These are updated as requested either by asking members/list receivers or by request from those receiving emails. I have always been happy that as we bling copy these emails that we include past members who move away but would still like to be kept up to date.

Phew.

This season's first observing session was very well attended, with prospective members and new members joining some old hands, with over a dozen people in attendance. Even blew the dust off my 12" Dobsonian and used it in angerto hunt planets, cluster and galaxies. Good to see Uranus and Neptune as well as Mars, Saturn and Jupiter. The Moon came up as the dew began to form on the telescopes but all in all a successful session despite thin cloud and rising mist with the car park lights not being covered (I forgot my step ladder).

Interesting to see John Dartnell's in camera star trails with the Canon G16. Impressive with our guest speaker for tonight being Mary McIntyre, who will be speaking about creating star trails in her presentation.

So good, I got a Canon G to try myself and with very little effort after downloading the manual I was taking a 90minute star trail as seen on the back page.

Thank you to Simon Franklin for taking over the reigns on the society website. Still some tweaking to get used to but he is now posting the monthly newsletter on the website.

Website: www.wasnet.co.uk

Clear Skies Andy

Also the topic for October is Star Trails here is the trail from Friday of the eastern night sky. Polaris is in the top left hand corner with Cepheus, Cassiopeia and Perseus left to right. There is a flare in the top right hand corner. Canon G16 in Star Trail mode – exposure 60 minutes.
120 images processed in camera, 28mm, F1.8, ISO 400, 30 sec.

Editors note: I was so impressed with the ease of this in camera star trail recording I researched around the Canon power shot range, and it is available on all the 'G' compact camera range. So much so I now have the G7 mark II…
See back page.

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

Meetings 2018/2019Season.

NEW VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

Date	Speaker	Title

2 Oct Mary McIntyre: Creating Stunning Star Trails.
6 Nov Pete Williamson: The Sun & How it Works.
4 Dec Dr Elizabeth Pearson: A very brief History of Rovers & Landers.
2019
15 Jan Open Forum/Beginners Meet.
5 Feb Prof. David Southwood: Mars: Delirium, Delight & Disasters, some personal stories.
5 Mar Martin Griffiths: 'Universal Death' or How the Universe is trying to kill us.
2 Apr Chris Starr: A Most beautiful Moon – A History of Lunar Exploration.
7 May Mark Radice: Observing the Solar System.
4 Jun Jon Gale: Observing the Herschel 400.

Mary McIntyre.

Mary McIntyre has had a lifelong passion for astronomy. She first saw Saturn as a young child, and has been fascinated by the night sky ever since, declaring at age six that one day she would be an astronaut! Sadly this was not to be but in 2011 she completed the Astronomy GCSE course, and in 2014 she completed the Open University Certificate in Astronomy and Planetary Science.

Mary has been an astrophotographer for about 8 years and loves to photograph just about anything that is in the sky! In her spare time she runs the UK Women in Astronomy Network, and writes astronomy blogs and articles for several online magazines and her own blog page. Her astrophotographs have been featured on BBC Sky at Night, BBC South Weather and a Channel 4 documentary about British Weather. She has appeared in All About Space Magazine, and has also had one of her photographs used as the cover for a university text book.
Mary has photographed nearly every flaring Iridium satellite. She is also an expert on atmospheric phenomena from rainbows to aurorae to noctilucent clouds, and in 2018 was elected a Fellow of the Royal Astronomical Society.

Every clear night she can found in her rural Oxfordshire garden with her camera!

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Keith Bruton Chair, keisana@tiscali.co.uk

Vice chair: Andy Burns and newsletter editor.
Email anglesburns@hotmail.com

Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)

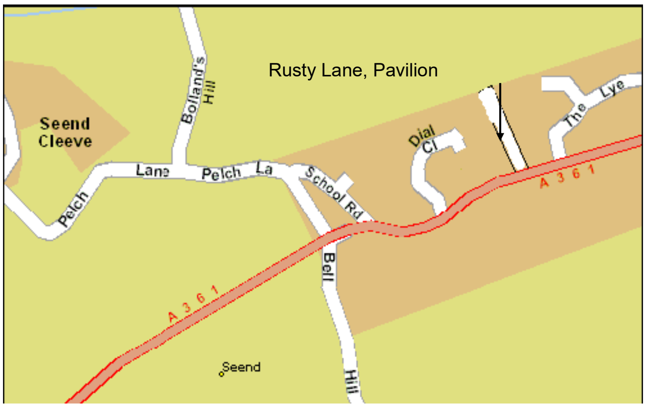
Philip Proven (Hall coordinator) Dave Buckle (Teas)

Peter Chappell (Speaker secretary)

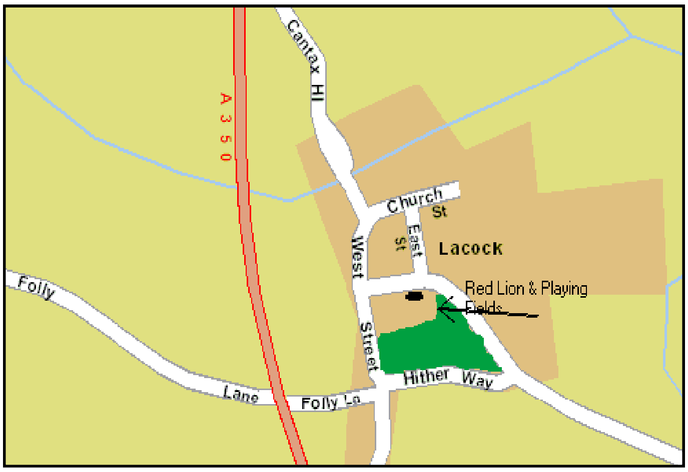
Nick Howes (Technical Guru)

Observing Sessions coordinators: Jon Gale, Tony Vale

Contact via the web site details. This is to protect individuals from unsolicited mailings.



Observing Sessions



The Wiltshire Astronomical Society's observing sessions are open, and we welcome visitors from other societies as well as members of the public to join us.
We will help you set up equipment (as often as you need this help), and let you test anything we have to help you in your choice of future astronomy purchases.
Please treat the lights and return to full working order before leaving. With enough care shown we may get the National Trust to do something with them!

PLEASE see our proposed changes to the observing sessions, contacting and other details. Back Page

Note this year we have moved away from the '4th Friday of the month' routine to get away from nights when the Moon is too bright to view other objects, so may be 1st Friday of month...

Swindon's own astronomy group

The club meets once a month at Liddington Hall, Church Road, Liddington, Swindon, SN4 0HB at 7.30pm. See programme below.

Stargazing Season

We have quite a few observers at Swindon Stargazers so we are very much looking forward to the winter season.

It begins with comet Giacobini-Zinner in the early hours of mornings throughout October. It was discovered by Michael Giacobini in December 1900, but then 're-discovered' by Ernst Zinner 6.5 years later. Its nucleus is about 2 km across. It can be seen west of Orion and Sirius, about 2º from Sirius in the middle of the month.

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.

When we use East Kennett, we meet at the public car park just below The Red Lion pub at Avebury; we usually hang on for 10 minutes and then move on to our viewing spot at East Kennett. Information about our evenings and viewing spots can be found here:

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

If you think you might be interested email the organiser Robin Wilkey (see website). 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!

Members of the Wiltshire Astronomical Society always welcome!

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.ht

Meeting Dates for 2018

Friday 19 October 2018
Programme: Dr. Michael McEllin - Radio Telescopes: How they work and what they can do

Friday 16 November 2018
Programme: Dr. Rhodri Evans - Astronomy from a Boeing 747

Friday 14 December 2018
Programme: Christmas Social

Meeting Dates for 2019

Friday 18 January 2019
Programme: TBA

Friday 15 February 2019
Programme: TBA

Friday 15 March 2019
Programme: AGM plus talk

Website:

http://www.swindonstargazers.co

Chairman: Peter Struve

Tel No: 01793 481547
Email: peter.struve@sky.com
Address: 3 Monkton Close, Park South, Swindon, SN3 2EU

Secretary: Dr Bob Gatten (PhD)
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Swindon, SN1 2JW

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.

21st September	*The Legacy of Apollo*	Nick Howes
19th October	*Comets*	James Fradgley
16th November	*Around the Universe in 40 minutes*	Grant Privett
7th December	Social Evening + bring and tell	
18th January	*The Mathematical Universe*	Steve Hill
15th February	*Journey to the Edge of the Solar System*	Chris Starr
15th March	*How Old Is It?*	Stephen Tonkin
26th April	*Observing and Sketching the Deep Sky*	Mark Radice
17th May	*The Herschel 400*	Jonathan Gale
21st June	Annual General Meeting *Member Talks*	

OCTOBER COMET

Every season, there are something like a dozen comets visible throughout the night. Most are faint, usually around magnitude 11–13, and require larger amateur instruments to see.

This time around, we have a wonderful exception — 21P/Giacobini-Zinner.

With an orbital period of 6.6 years, it's a regular visitor to our planet's night skies. G-Z's making a favorable approach at this apparition, passing just 58.6 million kilometers over the tops of our heads on September 10–11, the same date it reaches perihelion. That's just a few million kilometers shy of Mars's close brush with Earth this past July.

Fortuitously, 21P/G-Z is passing through the winter Milky Way and will make scenic pit stops near several bright, well-known star clusters. Watch for it to pass close to M37 on the night of September 9th and directly across M35 in Gemini on the morning of September 15th for the Americas.

The M35 crossing will be amazing to watch for several reasons. The comet enters the outskirts of the cluster around 7:30 UT (2:30 a.m. CDT) and exits about 11:30 UT (6:30 a.m.). Traveling at an apparent speed of 4.4′ per hour, anyone with a small telescope can watch it slowly slide across this famous Messier object as the wee hours tick by. With 120 stars brighter than magnitude 13 it's quite possible that 21P/G-Z's false nucleus — the bright condensation near the coma's center — will occult one or more of them along the way. The binocular view should be unique with the rich cluster appearing to sprout a tail!

Now this comet is very difficult to image, let alone see. The Moon is in the wrong position and it is headed for the morning glow part of the sky. Its surface brightness is closer to 10th magnitude.

Observe the Moon

By Jane Houston Jones and Jessica Stoller-Conrad

This year's International Observe the Moon Night is on Oct. 20. Look for astronomy clubs and science centers in your area inviting you to view the Moon at their star parties that evening!

On Oct. 20, the 11-day-old waxing gibbous Moon will rise in the late afternoon and set before dawn. Sunlight will reveal most of the lunar surface and the Moon will be visible all night long. You can observe the Moon's features whether you're observing with the unaided eye, through binoculars or through a telescope.

Here are a few of the Moon's features you might spot on the evening of October 20:

Sinus Iridum—Latin for "Bay of Rainbows"—is the little half circle visible on the western side of the Moon near the lunar terminator—the line between light and dark. Another feature, the Jura Mountains, ring the Moon's western edge. You can see them catch the morning Sun.

Just south of the Sinus Iridum you can see a large, flat plain called the Mare Imbrium. This feature is called a mare—Latin for "sea"—because early astronomers mistook it for a sea on Moon's surface. Because the Moon will be approaching full, the large craters Copernicus and Tycho will also take center stage.

Copernicus is 58 miles (93 kilometers) across. Although its impact crater rays—seen as lines leading out from the crater—will be much more visible at Full Moon, you will still be able to see them on October 20. Tycho, on the other hand, lies in a field of craters near the southern edge of the visible surface of the Moon. At 53 miles (85 kilometers) across, it's a little smaller than Copernicus. However, its massive ray system spans more than 932 miles (1500 kilometers)!

And if you're very observant on the 20th, you'll be able to check off all six of the Apollo lunar landing site locations, too!

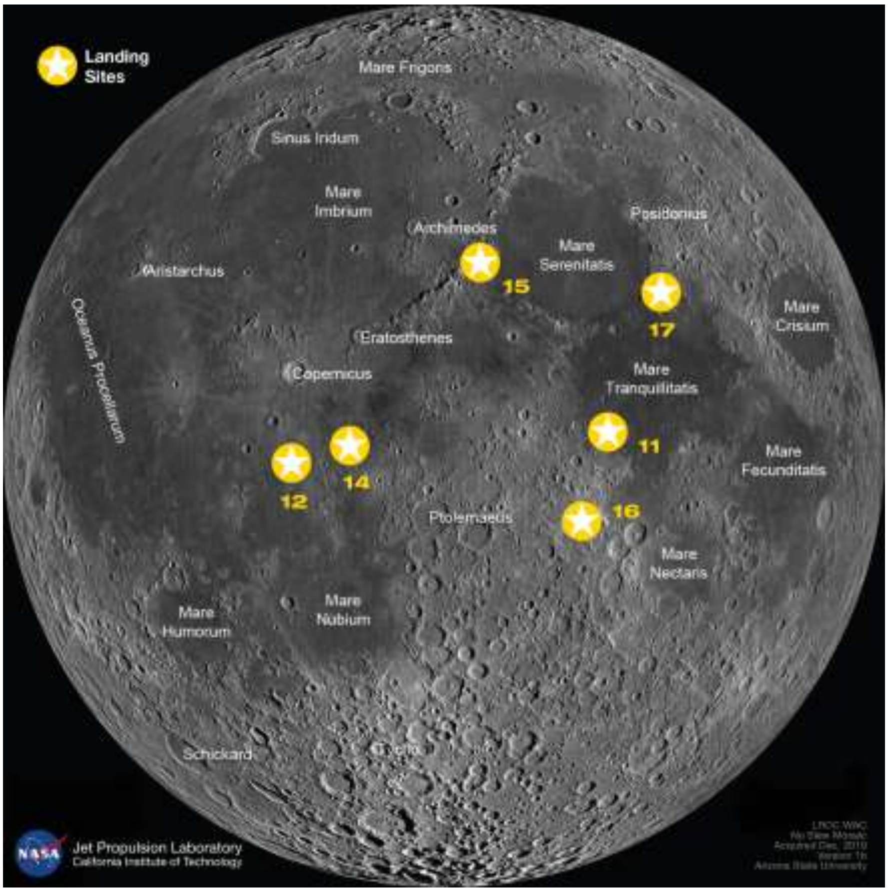
In addition to the Moon, we'll be able to observe two meteor showers this month: the Orionids and the Southern Taurids. Although both will have low rates of meteors, they'll be visible in the same part of the sky.

The Orionids peak on Oct. 21, but they are active from Oct. 16 to Oct. 30. Start looking at about 10 p.m. and you can continue to look until 5 a.m. With the bright moonlight you may see only five to 10 swift and faint Orionids per hour.

If you see a slow, bright meteor, that's from the Taurid meteor shower. The Taurids radiate from the nearby constellation Taurus, the Bull. Taurids are active from Sept. 10 through Nov. 20, so you may see both a slow Taurid and a fast Orionid piercing your sky this month. You'll be lucky to see five Taurids per hour on the peak night of Oct. 10.

You can also still catch the great lineup of bright planets in October, with Jupiter, Saturn and Mars lining up with the Moon again this month. And early birds can even catch Venus just before dawn!

You can find out more about International Observe the Moon Night at https://moon.nasa.gov/observe.



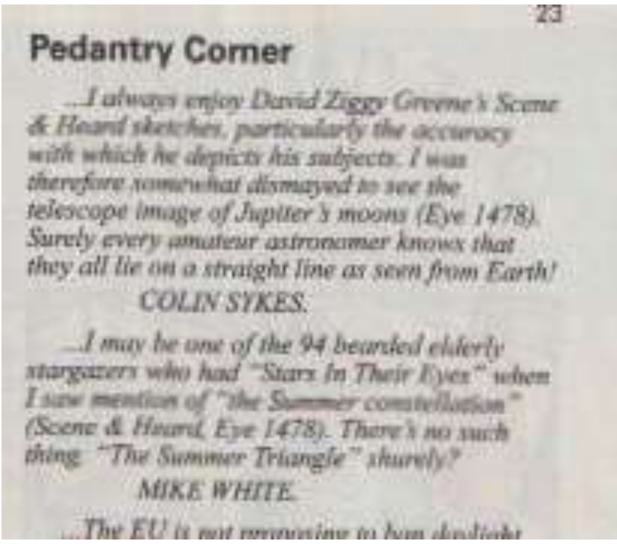
Caption: This image shows some of the features you might see if you closely observe the Moon. The stars represent the six Apollo landing sites on the Moon. Credit: NASA/GSFC/Arizona State University (modified by NASA/JPL-Caltech)

MEMBERS VIEWING LOGS and IMAGES

Hi Andy

You may be amused the image below. It appeared in a regular feature of Private Eye a fortnight ago. I don't know how easy it will be for you to pick out the detail but a telescopic view of Jupiter was shown with the Galilean moons in a most unusual alignment. And reference was made to "The Summer Constellation".

Needless to say these provoked a couple of PE correspondents with nothing better to do than to write in and point out the errors of the correspondent's ways. Their efforts appeared in a regular feature in this week's PE. Perhaps I shouldn't add that I was one of them.



23

Pedantry Corner

...I always enjoy David Ziggy Greene's Scene & Heard sketches, particularly the accuracy with which he depicts his subjects. I was therefore somewhat dismayed to see the telescope image of Jupiter's moons (Eye 1478). Surely every amateur astronomer knows that they all lie on a straight line as seen from Earth!

COLIN SYKES.

...I may be one of the 94 bearded elderly stargazers who had "Stars In Their Eyes" when I saw mention of "the Summer constellation" (Scene & Heard, Eye 1478). There's no such thing. "The Summer Triangle" shurely?

MIKE WHITE.

Clear skies

Mike

(I had seen this in private eye, and had hooked the copy out to scan myself. The author is notorious for his observation and accuracy of characters, if he heard wrong information he tends to print it as heard).

Viewing Log for 29th of September

After I had done a sunset session at Hackpen Hill (a popular hobby of mine if you have ever seen my Facebook page?) I thought I would carry on with astronomy and look at other stars in the sky!

So I drove just over a mile from Hackpen to my usual viewing spot near Uffcott just off the A4361 a few miles south of Swindon. As the sunset time was 18:49, I had some time before it would be dark enough for me to do any viewing and with the ISS due over at 19:47 I set up my camera gear ready to see if I could get any reasonable shots of it? Pictures taken (hopefully one or more will be alright?); I had my Meade LX 90 GOTO telescope set up and ready by 20:00. There were high thin Cirrus clouds to deal with, so this might have some effect of viewing dim objects? As I understand it was the same for the monthly WAS viewing session at Lacock which I totally forgot about! I would be using my Pentax 14 mm eye piece for tonight's session; I could just see Jupiter hanging above the horizon, so I turned the scope to this first. I could not make out any detail at all, could not even focus on the planet, well too low to view! So it was off to Saturn and see if that was any better? Being at -22 ° declination it was not in the best position? I could make out the rings and the moon Titan but nothing else, not much better on Mars, same declination but further east. No detail whatsoever! Let's hope I would have better times viewing dep sky objects? I had been keen to have a look in the Sagittarius area of the sky but the high hedge cancelled this out straight away! So I went slightly higher and looked in the Ophiuchus area. I would be using a rare thing for me and looking at my 'Sky & Telescope Pocket Atlas' for objects to view! I knew there were several Globular Clusters (G C) in the area, so I started with Messier (M) 12; this is a nice bright target to look at! Next were M 10 and M 14, both of these G C's where more compact and slightly dimmer to look at. Barnard's Galaxy, AKA Caldwell 57 was a faint fuzzy blob (FFB) to view. The Little Gem (NGC 6818) was a Planetary Nebula (P N) which looked similar to M 57, the Ring Nebula but smaller and fainter? Right on the border between Sagittarius/Capricornus is M 75, small tight G C which I have probably only seen twice before? Being so far away from the 'Teapot' asterism it is probably always overlooked unless you are doing the marathon? M 72 is another G C, which looked like a FFB; cloud probably did not help this target at all? All of a sudden I had a welcome guest turn up, I had texted Rob Slack (member of Swindon Stargazers) earlier in the evening about coming out to play and out he came J. After a long chat of about 20 minutes it was back to viewing and probably the second most boring object on Messier's list (after M 40) and M 73! This turns out to be just four stars close by; M 40 is a double star if you were wondering? The last object on the marathon list is M 30 (also in Capricornus); this G C was a faint blob to look at. If you are doing the marathon from the UK you cannot see this object when daylight returns as it is still below the horizon, you would have to travel much further south to bag all in one night? That was the last reference from the Star Atlas, all other items viewed would be from memory. So it was off to Pegasus and find M 15, this was similar to M 12, nice and bright to view. M 33, the Pinwheel Galaxy in Triangulum was hard to find, having a low surface brightness did not help! The Andromeda Galaxy in M 31 was the other end of the spectrum, had a bright centre even with the thin cloud around. M 32 a close neighbour to 31 was like M 75 to look at: small & tight. The Dumbbell Nebula in M 27 never fails me as does M 57, the Ring Nebula. These are probably the best P N's to look at? M 56 is another G C I really do not look at, all I can say about it is it looked okay! M 29 in Cygnus always gets a thumb up from me, my final object for the evening was M 39 a very loose Open Cluster. I think my telescope was looking thru the cluster? Reason for us to stop was the rising waning 76.4 % lit gibbous moon and cloud levels. The brightness of the moon was washing out a lot of deep sky objects L.

So with it being 22:29 we called it a day, the dew was pretty light but my equipment used tonight would still need to be dried out properly before being boxed up ready for the next session.

At least that is my first proper session of the current season; let's hope for more of them later in the season?

Peter Chappell

IMG 5023: Waning gibbous moon rising thru thin cloud with M45 above. Tech details: Canon 60 Da camera with 10 – 22 mm canon lens set at 20 mm, with a shutter speed of 13 seconds & aperture of f 5.6.

IMG 5033: 76.4 % waning gibbous moon (2 pictures put together). Tech details: Canon 60Da camera attached to LX 90 telescope with a shutter speed of 1/20th of a second & aperture of f 10.

IMG 4990a, Mars and Saturn in twilight just above a hedge! Tech details: Lens set at 22 mm, with a shutter speed of 3.2 seconds.

IMG 5003a, Track of ISS and an aircraft across the sky. Tech details: Lens set at 15 mm, with a shutter speed of 8 seconds. Both pictures taken with a Canon 60Da DSLR camera with a 10 – 22 mm Canon lens attached, ISO of 2000 & aperture of f 5.6.

Peter

Hi Andy,

Here are some images from viewing my sessions for the October 2018 Newsletter.

First, the Harvest Moon rise at Silbury Hill on Monday 24th September. The low Moon shows distortion due to the atmosphere.

Canon SX50HS, 1800mm (50x Optical and 25 x Digital) F8.0, 1/30 sec, ISO 100.

Second, the ISS pass from Friday's WAS meeting at Laycock.

Canon 1100D, Rokinon 8mm (effective focal length 13mm)

F3.5, 15 Sec, ISO 1600.
6 images layered with GIMP 2.

Also the topic for October is Star Trails here is the trail from Friday of the eastern night sky. Polaris is in the top left hand corner with Cepheus, Cassiopeia and Perseus left to right. There is a flare in the top right hand corner.
Canon G16 in Star Trail mode – exposure 60 minutes.
120 images processed in camera, 28mm, F1.8, ISO 400, 30 sec.
Continuing with Star Trails the final image is from my last trip to Tenerife in February 2017. Taken at the Rogues de Garcia in the Teide National Park.
Canon G16 in Star Trail mode – exposure 30 minutes.
60 images processed in camera, 28mm, F1.8, ISO 400, 30 sec.
Clear Skies,
John Dartnell

Pyjama Log
Viewing from 4:40am 11th September 2018
From Chippenham
Binoculars: Helios 10x60

Pulled out of bed by the sucker clear patch that included Orion and Sirius blazing through the window. Mentally come too, get dressed and go to the observatory and image the comet 21P Giacobini-Zinner or, checks sky and see moving cloud, just go outside the back door as I am with some binoculars… with a coffee within reach.

Straight into Auriga and search. Not inside the main rectangle. Am I sure? There is the Silver Sardine, and M38. Where is it? Open cluster King 8 just below M36. Both teasing me a little, but again sweeping through the lower Auriga exterior regions. M37. Nice. Hang on. Is that a small cluster below M37. Fuzzy. Hmmm I know there is one close to M35 in Gemini, and another ngc1907 is next to M38.

Recount the fuzzy clusters again. Now it is M37 and as my eyes' seeing begins to improve that little blob below right has a greenish tinge. Wow. Has the comet moved that much since last Thursday morning! Yes it has.

Looking back to Orion and M42/43 with the binoculars, then up to the Taurus Hyades and… cloud. Oh well. At least I got to view the comet again. Roll on Wednesday/Thursday night. It looks to be clear on weather forecasts. Where will the comet be? Should be halfway between M37 and M35…

Andy

Pyjama Log/Imaging log 13th Sept 2018

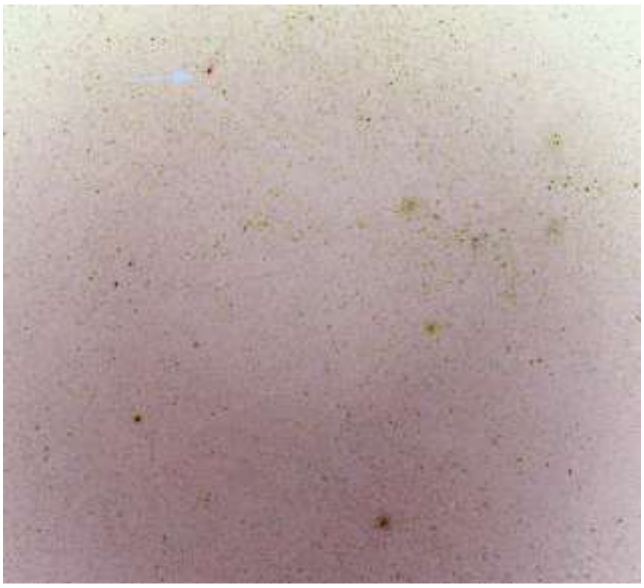
Set my internal alarm to get me up at 3:30 for the comet 21P/ Giacobini – Zinner.

Nicely awake at 3:15 started with the annoying light over neighbour's door lighting up the dome and my house (which, being white reflects light out across viewing zone). Bit annoyed as we spoke about how I'd be up early to view the comet yesterday… Anyway a black refuse bag over the light worked.

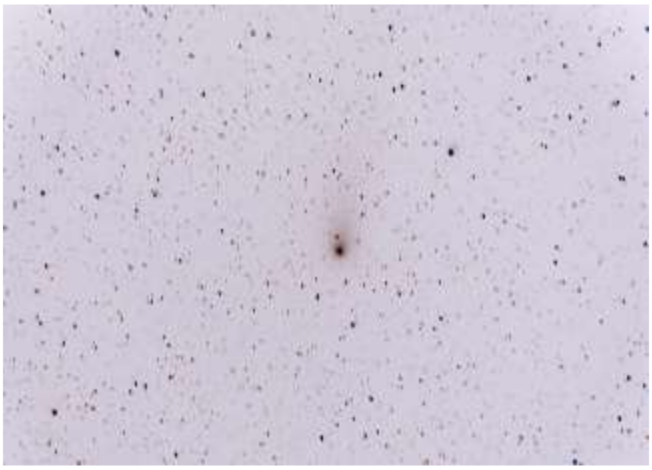
First binocular viewing to check the depth of seeing, comet 21P is only just visible in 11x80mm Vixen binoculars, but M35 and M37 open cluster very easy to see. On up through Auriga and round to Orion, all looking good. No clouds looming on the horizon but a little mist rising, going to be a dew laden morning. But the stars in M45 the Pleiades and the Hyades all looking like jewels on a black velvet background. Round into Perseus and the double cluster fantastic.

Make coffee, drink. Think loo… and I had better get dressed for the imaging from the telescope. Lots of sharp edges getting in there.

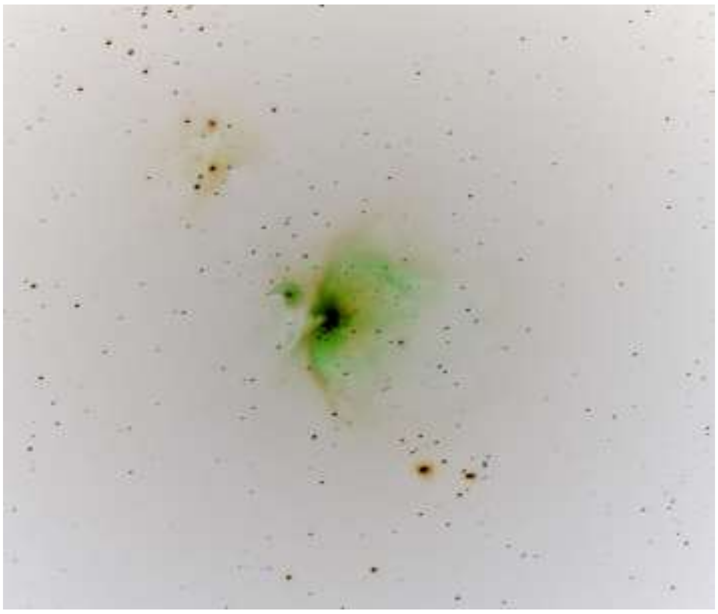
Make a viewing list while on the loo, these are vital if you want to keep an imaging session going, start with guide star (can be alignment star, bright enough to use on live view screen) to correct focus, then a couple of easy deep sky objects around main target to confirm alignment, then work progressively away from the comet, perhaps if longer exposure used on comet, then go to dimmer targets before changing exposure for last few brighter objects as the sky maybe getting lighter even at 4:30! By the time I was packing up a good 2hours before sunrise I could see without any lights to pack up and move in.



Set up gear, D850 with 85mm f1.8 lens on the Star Adventurer Mount, for wide-field images of the comet. Then prepare gear for telescope, trying out a 2x camera teleconverter rather than using a Barlow 2x in the telescopic line. I find the latter option gives me a huge backfocus to get everything lines up. This can introduce 'sag' because I need 2 extender 500mm AND 75mm, Big Barlow 2" 2x power and the camera mount connection 8 1/2" plus camera needs a lot of rebalancing between uses. The extender means I only have extender plus converter, around 3.5" in total and the change-over is 1.5" change, focus close to normal. Needed to try it out. Summary, an excellent, if expensive alternative, the Kenko Pro300 converter for Nikon is around £135, (the Nikon one is £350). But it fits nicely. In use, again I cannot emphasise highly enough use a bright star to get focus, and the alignment star is bright enough to do this. The only downside, if I were ultra-critical I would make some new flats for processing, the image cut-off vi-



gnette is quite marked but I would expect this using PowerMates or Barlows anyway. 9/10 if you get the right one, and you need that double focal length. Sacrifice would be the slower shutter speed (Nikon D810A is excellent as it can go up to 900seconds. ISO change is another way of coping with the reduced light, again these would be necessary using any Barlows or PowerMates.



My observing list ran from M35 to M37, then the comet between the two at 60s and 120s exposures, up to IC405 and ngc1893 around the Sardine end all at 120 seconds, back to 60 secs for

M36 and M38. M42 with M43, M78 with ngc2071, back to 120s for IC434 horsehead, and M1 at 60seconds, M45 at 60 and 30 seconds. I had to take Loer's nebula out of the run, top of Orion but too close to house and horizon was getting light for this dimmer Lynd's Bright Nebula.

Pack up and download files, convert RAWs and look at a couple. 6am and bed calls for a couple of hours.

Andy

We had an excellently attended viewing night at Lacock on Friday 28th September, though the local lighting and some mist over the river with high cirrus cloud meant the viewing was compromised we were graced with a near overhead space station pass, imaged with my 8mm fish eye lens on Nikon D800, and also some general images using my D810a with 85mm f2 lens but cirrus gives this camera a slight colour shift in the stars.

Moonrise was the final straw as the dew levels also increased on equipment.

Andy

Full Moon on the 25th and I went to Silbury Hill to capture the Moonroll creeping up the side of the hill. 60mm on zoom lens, Nikon D850 and ISS pass using 8mm on Nikon D800.

SPACE NEWS FOR JUNE

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

Sixty years after its birth, NASA remains a rare unifying force.

The space agency opened for business on Oct. 1, 1958, two months after its creation by the passage of the National Aeronautics and Space Act of 1958.

During the ensuing six decades, NASA has managed to inspire people throughout the country and around the world without getting too bogged down by partisan politics or the conflicts and controversies that have affected other branches of the U.S. government. [NASA's 10 Greatest Science Missions]

"NASA is one of the best — I hate to use the word, but I'll say it — brands that this country has," said John Logsdon, a professor emeritus of political science and international affairs at George Washington University's Elliott School of International Affairs in Washington, D.C. "It's projected an image of the United States that's really positive, and that reflects how we want to see ourselves — as a country of people who accomplish difficult things."

In terms of U.S. government activities, "there's been much less controversy about NASA than almost anything else," Logsdon told Space.com. "There never has been, and is not now, an anti-NASA lobby or interest group or public group. At a minimum, people say about NASA, 'Yeah, that's a good thing.' And a fair number of people say, 'That's great — that's what we should be doing.'"

Exploring the heavens

NASA's continued occupation of this rarefied air traces back to its founding document. The newly created agency's first objective, as laid out in the National Aeronautics and Space Act of 1958, involves "the expansion of human knowledge of phenomena in the atmosphere and space."

Though the Act does direct NASA to preserve the United States' leadership role in space science and technology, it also instructs the agency to facilitate "cooperation with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof." [Celebrate NASA's 60th Birthday with These Space Videos!]

And, in contrast to most previous space-related research in the United States and abroad, the military would not be leading the way.

"The United States wanted to make it clear that our space program was a civil effort and scientific effort," NASA Chief Historian Bill Barry said in a 60th-anniversary video posted by the space agency on July 29.

That effort has been famously fruitful. Just 11 years after its founding, NASA put boots on the moon. A total of 12 astronauts walked on the lunar surface during the Apollo era, and the agency brought all of them safely back to Earth.

NASA astronauts flew 135 space shuttle missions from 1981 through 2011. Many of these flights helped build or service the International Space Station (ISS), the orbital outpost that has hosted rotating astronaut crews on a continuous basis since November 2000. NASA has been a driving force behind the ISS, a multinational effort involving more than a dozen partners, from the very beginning.

Pluto, as seen by NASA's New Horizons spacecraft during its epic flyby of the dwarf planet in July 2015.

Credit: NASA/JHUAPL/SwRI

And then there are the robotic exploration missions — far too many to rattle off here, even as a bare-bones list. NASA spacecraft have studied the sun up close and visited every currently or originally recognized planet, from Mercury all the way out to Pluto, as well as some asteroids, comets and dwarf planets. (Many NASA spacecraft have also studied their home planet from Earth orbit over the years, of course.) The agency has put a host of landers and rovers on the moon and Mars as well. [Destination Pluto: NASA's New Horizons Mission in Pictures]

NASA in situ exploration now extends into interstellar space: The far-flung Voyager 1 probe popped free of the sun's sphere of influence in August 2012, and its twin, Voyager 2, is poised to do the same soon.

And we can't forget the many astrophysics missions — such as the Wilkinson Microwave Anisotropy Probe and the Hubble, Chandra and Spitzer space telescopes — that have brought distant, mysterious objects into clear view and reshaped astronomers' understanding of the universe's structure and evolution.

Also on the astrophysics side: The Kepler space telescope has found about 70 percent of the 3,800 known exoplanets, and its recently launched successor, the Transiting Exoplanet Survey Satellite, may be even more prolific.

The discoveries made by all of these missions have opened eyes around the world — and so have the gorgeous photos delivered by Hubble, the Saturn-orbiting Cassini spacecraft and many other NASA probes.

The next 60 years

NASA will continue to do groundbreaking robotic exploration for decades to come. But the agency's cultural and societal influence may wane in the future as private spaceflight matures and starts doing big things in the flashy realm of crewed exploration, Logsdon said. [NASA's 60th Anniversarsy Puts Its History Office in the Spotlight]

Those big things may include helping to establish human settlements on Mars and other deep-space destinations, as both SpaceX and Blue Origin — which are led by the billionaire entrepreneurs Elon Musk and Jeff Bezos, respectively — aim to do.

But NASA is working to send humans out into deep space as well, something the agency hasn't done since the Apollo 17 astronauts returned from their moon mission in December 1972. This push really began in 2004 with President George W. Bush's Vision for Space Exploration, which called for NASA to retire the space shuttle program by 2010 and put boots on the moon again by 2020.

"We have not argued since then that going beyond Earth orbit is the right thing to do," Logsdon said. "We've been slow about doing it, but there hasn't been a counter-argument."

NASA's current plan involves the construction of a small space station in lunar orbit by the mid-2020s. The outpost, known as the Lunar Orbital Platform-Gateway, will serve as a jumping-off point for missions to the moon's surface, both robotic and crewed. And, NASA officials say, the skills learned during the construction and operation of the Gateway will help humanity get to Mars, which the agency aims to do in the 2030s, in cooperation with international and commercial partners.

This journey to Mars could end up being the grandest adventure of the 21st century, one that future generations recall more clearly, and with even greater reverence, than the gray-haired among us regard the Apollo missions.

NASA Report Outlines How it Will Go Back to the Moon, to Mars, and Beyond in a Sustainable Way

In the coming decades, NASA intends to mount some bold missions to space. In addition to some key operations to Low Earth Orbit (LEO), NASA intends to conduct the first crewed missions beyond Earth in over 40 years. These include sending astronauts back to the Moon and eventually mounting a crewed mission to Mars.

To this end, NASA recently submitted a plan to Congress that calls for human and robotic exploration missions to expand the frontiers of humanity's knowledge of Earth, the Moon, Mars, and the Solar System. Known as the National Space Exploration Campaign, this roadmap outlines a sustainable plan for the future of space exploration.

This plan was issued in response to Space Policy Directive -1, which was issued in December of 2017 by President Donald Trump. The directive called for the NASA administrator to:

"[L]ead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations."

Full Moon, as imaged by NASA's Lunar Reconnaissance Orbiter. Credit: NASA Goddard's Scientific Visualization Studio

The plan is also consistent with the NASA Transition Authorization Act of 2017, which approved of $19.5 billion in funding for NASA for fiscal year 2017. This act sought to maintain transitional funding in order to ensure that NASA can continue planning its return to the Moon, send astronauts to Mars, as well as maintain a continued commitment to the International Space Station and the utilization of Low Earth Orbit, and other related space ventures.

The Campaign Report contains five goals for revitalizing NASA's leadership in space while ensuring sustainability for future spaceflight. They include:

Transition U.S. human spaceflight activities in low-Earth orbit to commercial operations that support NASA and the needs of an emerging private sector market.

Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space.

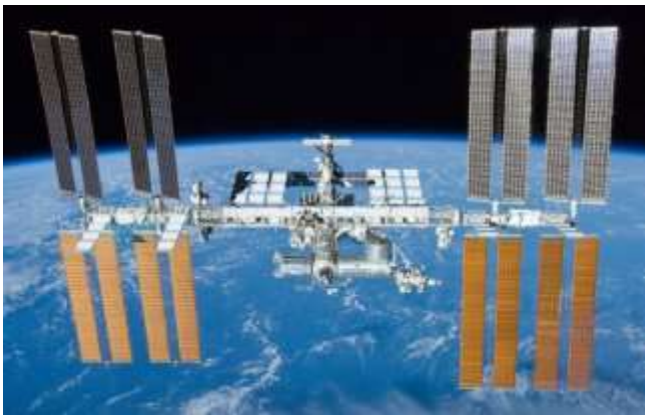
Foster scientific discovery and characterization of lunar resources through a series of robotic missions.

Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and use.

Demonstrate the capabilities required for human missions to Mars and other destinations.

Low-Earth Orbit (LEO):

When it comes to operations in LEO, NASA intends to transition from the current model to one where the government is one of several customers for commercial services. In short, NASA intends to transition from direct government-funding to commercial services and partnerships. This aspect of the plan will also involve independent commercial platforms or a non-NASA operating model for the International Space Station by 2025.



The International Space Station (ISS), seen here with Earth as a backdrop. Credit: NASA

In the meantime, the ISS will continue to function as a core long-duration human spaceflight platform until at least 2024. It will also serve as a testbed for developing strategies to keep crews healthy and productive on deep space missions, and to develop technologies in support of those missions – i.e. advanced robotics, communications, medicine, agriculture and environmental science.

The space station is also expected to play a key role in enabling the transition to commercial activities in LEO. These are likely include the deployment of broadband internet satellites, CubeSats, research platforms, non-government space stations and habitats, and maybe even a space hotel or two!

Back to the Moon:

In the Campaign Report, NASA identifies the Moon as a fundamental part of Earth's past and future. AS they state, "Although Americans first walked on its surface almost 50 years ago, our explorers left only fleeting footprints at a few sites, over a total of 16 days on the surface. The next wave of lunar exploration will be fundamentally different."

Intrinsic to this are the planned lunar missions that will rely on the Space Launch System (SLS) and the Orion Multi-Purpose Crew Vehicle (MPCV). The first mission to test the Orion capsule (Exploration Mission-1) – which will take place in 2020 – will consist of an uncrewed Orion capsule being sent into orbit around the Moon and then returning to Earth.

This will be followed by Exploration Mission-2, which will consist of astronauts orbiting the Moon in 2023, with a crewed mission to the lunar surface happening no later than the late 2020s. This will be the first time that astronauts have traveled to the Moon since 1972. It will also leverage international and commercial partnerships to develop a long-term human presence on the Moon.

As they state in the Campaign Report, missions to the lunar surface it will also open up considerable opportunities for scientific research:

"Bombarded by solar and cosmic radiation for billions of years and left largely undisturbed, the Moon is a historic archive of our Sun and solar system. Scientific discoveries are locked in its regolith that could lead to improved understanding of our own planet and its evolution. It also harbors resources, such as water, that are among the rarest and most precious commodities in space, offering potential sustenance and fuel for future explorers."

Another major goal involving the Moon is the construction of the Lunar Orbital Platform-Gateway (LOP-G), formerly-known as the Deep Space Gateway. This orbital habitat will allow for longer stays on the lunar surface, to navigate to different lunar orbits, and easier returns to Earth. It will also act as a safe haven in the event of an emergency on the surface, such as a meteor strike.

Artist illustration of Habitation Module aboard the Deep Space Gateway. Credit: Lockheed Martin

Consistent with NASA's "Journey to Mars", the Gateway will also validate key technologies and systems that will go into the Deep Space Transport (aka. Mars Transit Vehicle) – the spacecraft which will take astronauts to Mars. By the late 2020s, a lunar lander will begin making trips to the surface of the Moon, where astronauts will train for an eventual mission to the surface of Mars.

Last, but not least, the Gateway will serve as a laboratory for testing the effects of microgravity and radiation on living organisms beyond LEO. These experiments will prove vital to conducting deep space missions to Mars and beyond. This platform will be assembled in space incrementally with the first element (the power and propulsion element) being launched by 2022.

Journey to Mars:

And then, there is the plan to send astronauts to Mars, which NASA still hopes will happen by the 2030s. For this part of the plan, the focus is on the development of key robotic and human missions that will extend lessons learned from lunar missions to Mars. The plan also involves several missions which are already en route to Mars or currently in development.

These include NASA's Interior Exploration using *Seismic Investigations, Geodesy and Heat Transport* (InSight) mission, which is due to land on Mars this November and will study the interior of the Red Planet. Meanwhile, the *Mars 2020* rover is still in development and will launch by July of 2020. Once it arrives on Mars, this rover will extend the search for past life on the Red Planet and demonstrate how local resources can be used to aid in exploration.

Artist's impression of the Mars Base Camp in orbit around Mars. When missions to Mars begin, one of the greatest risks will be that posed by space radiation. Credit: Lockheed Martin

According to the Campaign Report, the *Mars 2020* mission also will also serve as a building block for a subsequent round-trip robotic mission. Essentially, this mission will involve landing a rocket on Mars, retrieving the samples obtained by the *Mars 2020* rover, then returning them to Earth. It will also serve as a critical precursor to an eventual series of crewed missions to Mars.

Another key point in this part of the plan is the creation of orbital infrastructure that will allow human missions in orbit around Mars and to the surface. Already, NASA has contracted with Lockheed Martin to develop the Mars Base Camp concept, which is similar to the Gateway in that it will remain in orbit around Mars, have its own lander vehicle, and will facilitate missions to and from the surface.

In summary, the Campaign Report indicates that NASA will continue to leverage partnerships between the US government, the private sector and international partners to create a sustainable means of space exploration. It also acknowledges a debt to the Apollo era, which blazed the trail that the current and next-generation of astronauts will be following:

"We are fortunate that many of the critical technologies pioneered by the Apollo missions – microelectronics, power storage, propulsion technology, advanced materials, and others – have become major industrial sectors backed by decades of innovation and improvement. From this advantageous starting position, we intend to rapidly integrate advanced capabilities with our own new technology and take one giant leap toward the sustainable and long-term human and robotic space exploration of the solar system."

Titan First-Ever Detected Dust Storms Proves the Moon to be More Earth-like than Ever

Ever since the *Cassini* orbiter entered the Saturn system in July of 2004, scientists and the general public have been treated to a steady stream of data about this ringed giant and

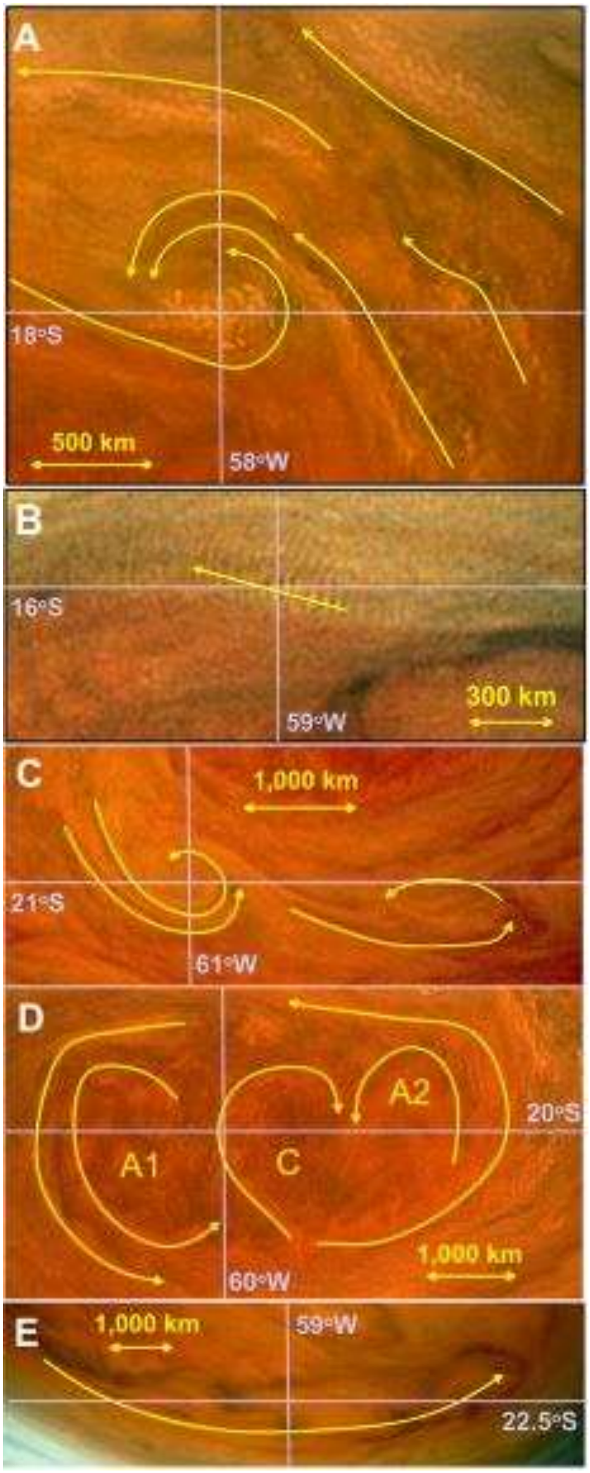
its many fascinating moons. In particular, a great deal of attention was focused on Saturn's largest moon Titan, which has many surprising Earth-like characteristics.
These include its nitrogen-rich atmosphere, the presence of liquid bodies on its surface, a dynamic climate, organic molecules, and active prebiotic chemistry. And in the latest revelation to come from the *Cassini* orbiter, it appears that Titan also experiences periodic dust storms. This puts it in a class that has so far been reserved for only Earth and Mars.

JunoCam Wows Us Again With Detailed Images of the Great Red Spot

For almost 200 years humans have been watching the Great Red Spot (GRS) on Jupiter and wondering what's behind it. Thanks to NASA's Juno mission, we've been getting better and better looks at it. New images from JunoCam reveal some of the deeper detail in our Solar System's longest-lived storm.
JunoCam is the visible light instrument onboard NASA's Juno mission to Jupiter. It's not part of the Juno spacecraft's primary scientific payload. It was included in the mission just to engage and thrill us, and it hasn't disappointed. But as it turns out, JunoCam's high-resolution images are serving a scientific purpose.
A new study led by Agustín Sánchez-Lavega (University of the Basque Country, Spain) has used the detailed images from JunoCam to look more closely at the morphology of the clouds that make up the GRS. Up until now most of what we know about the GRS has come from previous missions to Jupiter. First were the Voyager missions, then the Galileo mission, and of course the Hubble Space Telescope. The image resolution of each succeeding mission has improved, but nothing close to JunoCam's resolution.

Images of Jupiter's Great Red Spot have gotten better over the decades. On the left is an image from the Voyager mission, middle is an image from the Galileo mission, and on the right is a Hubble Space Telescope Image. Image: NASA/ESA/Evan Gough
As image quality improved from as poor as 150 km/pixel to as fine as 7 km/pixel, our understanding of the GRS has improved along with it. The paper from Sanchez-Lavega focuses on five particular morphological features of the storm: compact cloud clusters, mesoscale waves, spiraling vortices, the central turbulent nucleus, and filament structures.

JunoCam image of the Great Red Spot showing: (A) compact cloud clusters; (B) mesoscale waves; (C) spiraling vortices; (D) a central turbulent nucleus; (E) examples of elongated thin dark gray filaments. Image: NASA/A. Sanchez-Lavega et. al.
Compact cloud clusters resemble altocumulus clouds in Earth's atmosphere and may suggest the condensation of ammonia.
Mesoscale waves are wave packets that could indicate regions of stability.
Spiralling vortices are eddies with a radius of about 500 km that indicated intense horizontal wind shear.
The central turbulent nucleus of the GRS is about 5200 km long, or about 40% of Earth's diameter.
Large dark, thin, undulating filaments from 2,000 to 7,000 km in length move at very high speed around the outside of the vortex. They may have a different composition than other features or they could be a different altitude.



The study identifies five different morphological features in the Great Red Spot. From top to bottom: compact cloud clusters, mesoscale waves, spiraling vortices, the central turbulent nucleus, and large dark thin filaments. Image: American

Astronomical Society/Sanchez-Lavega et al.
The study determines that although the size of the GRS has changed dramatically over the last 140 years, the winds have changed only modestly since 1979, when the Voyager missions visited Jupiter. The authors suggest that a “deeply rooted dynamical circulation” maintains these wind speeds. Further, they suggest that the rich morphologies in the top of the GRS reflect the dynamics at the cloud tops.
From the study:
A comparison with high-resolution images from previous missions suggests a high temporal variability in the dynamics of this layer, strongly enforced by the interaction of the GRS with phenomena close in latitude (Sánchez-Lavega et al. 1998, 2013). However, while the size of the GRS has changed strongly in the last 140 years (Rogers 1995; Simon et al. 2018), the wind field in the GRS shows modest changes during the period 1979–2017 (Figure 6) implying a deeply rooted dynamical circulation. The rich GRS cloud-top morphologies embedded in these winds reflect the dynamics at the top of the system.
Scientist’s are still working on a deeper understanding of Jupiter’s atmosphere and how the GRS is formed and maintained. Instruments on the Juno spacecraft will help with this, as will the Hubble. Juno’s Microwave Radiometer (MWR) is designed to study the hidden structure beneath Jupiter’s morphologically stunning cloud tops. The MWR should be able to probe the Jovian atmosphere to a depth of 550 km. It has already revealed that some atmospheric features visible on the surface actually extend to a depth of at least 300 km.
The authors of the study sum it up best: “Our knowledge about the GRS dynamics will increase further, thanks to the ongoing studies on the vertical gravity soundings and the observations with the MWR instrument onboard Juno, together with a supporting campaign from the HST, Earth-based telescopes, and the planned future James Webb Space Telescope (Norwood et al. 2016) of this unique and fascinating phenomenon.”
Sources:
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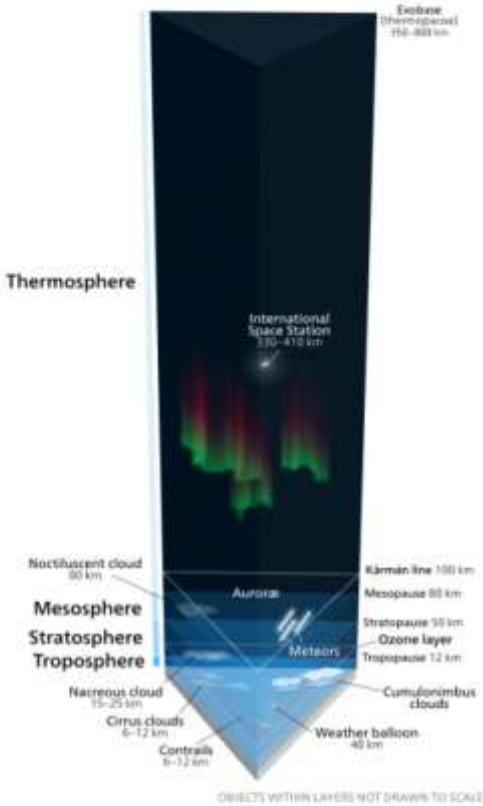
Noctilucent Clouds Perform Delicate Dance for NASA’s Balloon-Cam

Noctilucent clouds are one of the atmosphere’s most ethereal natural wonders. They form high in the mesosphere, about 80 km (50 mi) above the Earth’s surface, and are rarely seen. In July, 2018, NASA launched a five-day balloon mission, called PMC (Polar Mesospheric Clouds) Turbo, to observe them and photograph them.
Noctilucent clouds are more properly called Polar Mesospheric Clouds, because they form in the mesosphere over the Earth’s poles. They can’t be seen in daylight because they are too faint. They can only be seen when the Sun is below the observer’s horizon, and when the lower layers of the atmosphere are in the shadow of the Earth.
“From what we’ve seen so far, we expect to have a really spectacular dataset from this mission.” – Dave Fritts, Principal Investigator of the PMC Turbo mission.
Noctilucent clouds are not fully understood, which is why NASA launched the PMC Turbo mission. It launched from Estrange, Sweden, and travelled for five days across the Arctic to Western Nunavut, Canada. The mission captured 6 million high-resolution images that filled up 120 TB of data.

Noctilucent clouds (PMC’s) over Kuresoo Bog, Soomaa National Park, Estonia. Image Credit: By Martin Koitmäe [1] – Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=10752455
“From what we’ve seen so far, we expect to have a really spectacular dataset from this mission,” said Dave Fritts, principal investigator of the PMC Turbo mission at Global Atmospheric Technologies and Sciences in Boulder, Colorado. “Our cameras were likely able to capture some really interesting events and we hope will provide new insights into these complex dynamics.”
Noctilucent clouds are made of ice crystals high in the mesosphere. They form on the remnants of meteors that have burned up in the atmosphere. Studying them will help scientists understand the role of turbulence in the atmosphere and bodies of water. They should help scientists understand the atmospheres on other planets too, and could lead to better weather forecasting.
The clouds get their delicate shapes from what are known as atmospheric gravity waves. These waves are the result of uplifted air masses over mountain ranges, so studying the clouds will help us understand the role gravity waves play in the Earth’s atmosphere, and how they transfer energy through the layers of the atmosphere.



he layers of the Earth's atmosphere. Noctilucent clouds are shown in the mesosphere. Image: By Kelvinsong – Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=24006541

"This is the first time we've been able to visualize the flow of energy from larger gravity waves to smaller flow instabilities and turbulence in the upper atmosphere," Fritts said. "At these altitudes you can literally see the gravity waves breaking — like ocean waves on the beach — and cascading to turbulence."

"We know the 2D wave structure from the images, but in order to fully describe the waves we need to measure the third dimension as well." – Bernd Kaifler, German Aerospace Center.

PMC Turbo's unique mission design combines seven imaging systems which created a mosaic of wide views covering 100 miles across. Each of the seven consists of a hi-res camera, a computer control and communications system, and 32 TB of data storage capability. The cameras can also capture turbulence features as small as 18 m. (20 yards) wide.

Noctilucent clouds over the Antarctic. Image: NASA

PMC Turbo also employed a laser radar, or LIDAR, that allowed precision altitude measurements of the PMCs. The LIDAR also measure the temperature fluctuations of the gravity waves above and below the PMCs. LIDAR gave the scientists a third dimension to their data, to go along with all the imaging data.

"We know the 2D wave structure from the images, but in order to fully describe the waves we need to measure the third dimension as well," said Bernd Kaifler, the researcher at the German Aerospace Center, in Wessling, Germany, who designed the balloon's lidar experiment. "From the lidar measurements, we can infer the vertical structure of the waves, thus providing important data which would have not been available from the imaging experiment alone."

The PMC Turbo mission is part of a larger NASA endeavour to understand Earth's atmosphere and weather. NASA uses several satellites, and sub-orbital instruments like the PMC Turbo balloon mission, to examine atmospheric phenomena from different perspectives. The Aeronomy of Ice and the Mesosphere (AIM) spacecraft is also studying noctilucent clouds.

AIM and PMC Turbo are like a one-two punch when it comes to studying noctilucent clouds. AIM looks at the large-scale views of the clouds across the globe, and PMC Turbo is filling in the gaps with close-up views.

Learning about the causes and effects of PMCs and the turbulence that shapes them will help scientists understand not only the structure and variability of the upper atmosphere. It will help them turbulence in areas as well. Turbulence occurs in fluids across the universe and the results will help scientists better model it in all systems. Ultimately, the results will even help improve weather forecast models.

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Narrowing Down the Mass of the Milky Way

Since the birth of modern astronomy, scientists have sought to determine the full extent of the Milky Way galaxy and learn more about its structure, formation and evolution. At present, astronomers estimate that it is 100,000 to 180,000 light-years in diameter and consists of 100 to 400 billion stars – though some estimates say there could be as many as 1 trillion.

And yet, even after decades of research and observations, there is still much about our galaxy astronomers do not know. For example, they are still trying to determine how massive the Milky Way is, and estimates vary widely. In a new study, a team of international scientists presents a new method for weighing the galaxy based the dynamics of the Milky Way's satellites galaxies.

The study, titled "The mass of the Milky Way from satellite dynamics", recently appeared in the *Monthly Notices of the Royal Astronomical Society.* The study was led by Thomas Callingham from the University of Durham's Institute of Computational Cosmology, and included members from the Massachusetts Institute of Technology (MIT), the Heidelberg Institute for Theoretical Studies, and multiple universities.

Artist's impression of the Milky Way Galaxy. Credit: NASA/JPL-Caltech/R. Hurt (SSC-Caltech)

As they indicate in their study, the mass of the Milky Way is fundamental to our understanding of astrophysics. Not only is it important in terms of placing our galaxy into the context of the general galaxy population, but it also plays a major role when addressing some of the greatest mysteries that arise from our current astrophysical and cosmological theories. These include the intricacies of galaxy formation, discrepancies with the current Lambda Cold Dark Matter (Lambda CDM) model, alternative theories on the nature of dark matter, and the large-scale structure of the Universe. What's more, previous studies have been hampered by a number of factors, which include the fact that the Milky Way's dark matter halo (which makes up most of its mass) cannot be observed directly.

Another major issue is the fact that it is difficult to measure the extent and mass of the Milky Way because we are within it. As a result, previous studies that have attempted to infer the mass of our galaxy resulted in mass estimates ranging from about 500 billion to 2.5 trillion times the mass of our Sun (Solar masses). As Callingham explained to Universe Today via email, refined approach was needed:

"The majority of the galaxy is in its dark matter halo, which cannot be directly observed. Instead, we infer its properties through observations of various dynamical tracers that feel the gravitational effects of the dark matter – such as stellar populations, globular clusters, steams and satellite galaxies. Most of these lie at the center of a our galaxy in the the galactic disc (within ~10kpc) and the stellar halo (~15kpc) which can give good mass estimates of the inner region. However the DM halo reaches ~200kpc, and for this reason we chose to focus on satellite galaxies, as one of the only tracers that probe these outer parts of the galaxy."

The Gaia mission's first sky map. Credit: ESA / Gaia / DPAC / A. Moitinho & M. Barros, CENTRA – University of Lisbon.

For the sake of their study, the team relied on data from the Gaia satellite's second data release (DR2 release) to place better constraints on the Milky Way's mass. The Gaia mission, which has provided more information than ever before about our galaxy, includes the position and relative motions of countless stars in the Milky Way – including those that are in satellite galaxies. As Callingham indicated, this proved very useful for constraining the mass of the Milky Way:

"We compare the orbital properties Energy and Angular Momentum of the MWs satellite galaxies to those found in simulations. We used the latest observations of the MWs satellites from the recent Gaia DR2 dataset and a sample of suitable galaxies and satellite galaxies from the EAGLE simulations, a leading simulation ran in Durham with a large volume and full hydrodynamical baryonic physics."

The EAGLE software (Evolution and Assembly of GaLaxies and their Environments), which was developed by Durham University's Institute of Computational Cosmology, models the formation of structures in a cosmological volume measuring 100 Megaparsecs on a side (over 300 million light-years). However, using this software to infer the mass of the Milky Way presented some challenges.

"A challenge to this is the limited sample of MW size galaxies in EAGLE (or indeed any simulation)," said Callingham. "To help this we use a mass scaling relation to scale our total sample of galaxies to be the same mass. This allows us to effectively use more from our dataset and greatly improves our statistics. Our method was then rigorously tested by finding the mass of simulated galaxies from EAGLE and the Auriga simulations – an independent suite of high resolution simulations. This ensures that our mass estimate is robust and has realistic errors (something the field sometimes struggles with due to analytic assumptions)."

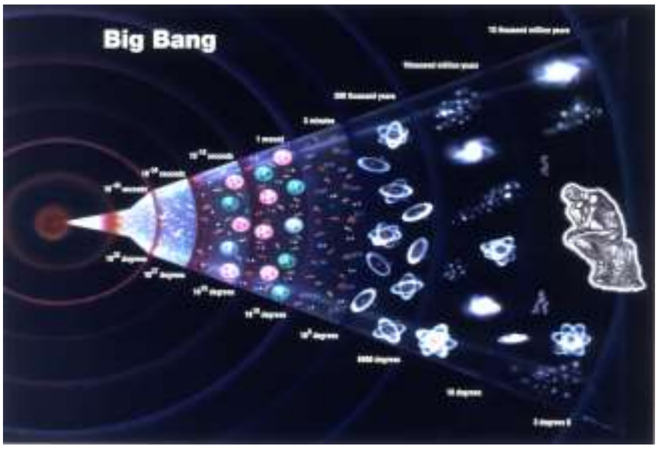
All galaxies are thought to have a dark matter halo. This image shows the distribution of dark matter surrounding our very own Milky Way. Image credit: J. Diemand, M. Kuhlen and P. Madau (UCSC)

From this, they found that the total halo mass of the Milky Way was about 1.04 x 10^{12} (over 1 trillion) Solar Masses, with a 20% margin of error. This estimate places much tighter constraints on the Milky Way's Mass than previous estimates, and could have some significant implications in the fields of astronomy, astrophysics and cosmology. As Callingham summarized:

"A tighter mass estimate can be used in many ways. In galaxy modelling, the DM halo is the backdrop on which stellar components are fit. Many methods to probe the nature of DM, such as the structure of the DM halo, as well as the density of DM on Earth for direct detection purposes depend on the mass of the MW. The mass can also be used to predict the number of satellite galaxies around the MW that we expect."

In addition to providing astronomers with refined measurements of the Milky Way's mass – which will go a long way towards informing our understanding of its size, extent, and satellite galaxy population – this study also has implications for our understanding of the Universe as a whole. What's more, it is yet another groundbreaking study that was made possible through *Gaia's* second data release.

The third release of *Gaia* data is scheduled to take place in late 2020, with the final catalog being published in the 2020s. Meanwhile, an extension has already been approved for the *Gaia* mission, which will now remain in operation until the end of 2020 (to be confirmed at the end of this year).



How to Know Once and For All if the Universe Began With a Bang or a Bounce

According to the Big Bang cosmological model, our Universe began 13.8 billion years ago when all the matter and energy in the cosmos began expanding. This period of "cosmic inflation" is believed to be what accounts for the large-scale structure of the Universe and why space and the Cosmic Microwave Background (CMB) appear to be largely uniform in all directions.

However, to date, no evidence has been discovered that can definitely prove the cosmic inflation scenario or rule out alternative theories. But thanks to a new study by a team of astronomers from Harvard University and the Harvard-Smithsonian Center for Astrophysics (CfA), scientists may have a new means of testing one of the key parts of the Big Bang cosmological model.

Their paper, titled "Unique Fingerprints of Alternatives to Inflation in the Primordial Power Spectrum", recently appeared online and is being considered for publication in the *Physical Review Letters*. The study was conducted by Xingang Chen and Abraham Loeb – a senior lecturer at Harvard University and the Frank D. Baird Chair of Astronomy at Harvard University, respectively – and Zhong-Zhi Xianyu, a postdoctoral fellow with the Department of Physics at Harvard University.

To recap, in physical cosmology, the theory of cosmic inflation states that at 10^{-36} seconds after the Big Bang, the singularity where all matter and energy was concentrated began to expand. This "Inflationary Epoch" is believed to have lasted until 10^{-33} to 10^{-32} seconds after the Big Bang; after which, the Universe began to expand more slowly. In accordance with this theory, the initial expansion of the Universe was faster than the speed of light.

The theory that such an epoch existed is useful for cosmologists because it helps explain why the Universe has nearly the same conditions in regions that are very distant from each other. Basically, if the cosmos originated from a tiny volume of space that was inflated to become bigger than we can currently observe, it would explain why the large-scale structure of the Universe is nearly uniform and homogeneous.

However, this is by no means the only explanations for how the Universe came to be, and the ability to falsify any of them has been historically lacking. As Professor Abraham Loeb told Universe Today via email:

"Although many observed properties of the structures within our universe are consistent with the inflation scenario, there are so many models of inflation that it is difficult to falsify it. Inflation also led to the notion of the multiverse in which anything that can happen will happen an infinite number of times, and such a theory is impossible to falsify through experiments, which is the trademark of traditional physics. By now, there are competing scenarios that do not involve inflation, in which the universe first contracts and then bounces instead of starting at a Big Bang. These scenarios could match the current observables of inflation."

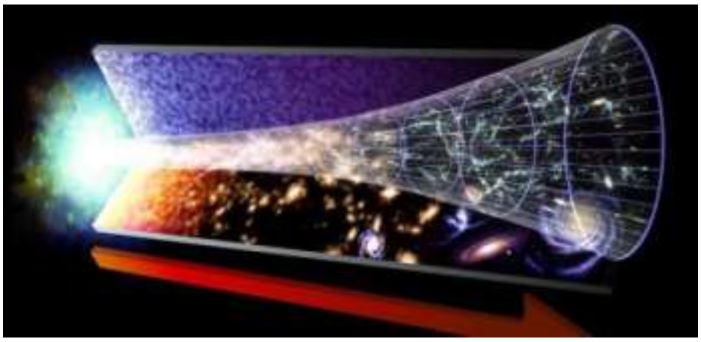
For the sake of their study, Loeb and his colleagues developed a model-independent way of distinguishing inflation from alternative scenarios. Essentially, they propose that massive fields in the primordial universe would experience quantum fluctuations and density perturbations that would directly record the scale of the early Universe as a function of time – i.e. they would act as a sort of "standard clock of the Universe".

By measuring the signals that they predict would be coming from these fields, they hypothesize that cosmologists would be able to tell if any variations in density were seeded during a contracting or an expanding phase of the early Universe. This would effectively allow them to rule out alternatives to cosmic inflation (such as the Big Bounce scenario). As Loeb explained:

"In most scenarios it is natural to have a massive field in the early universe. The perturbations in the massive field on a particular spatial scale oscillate in time like a ball going up and down in a potential well, where the mass dictates the frequency of the oscillations. But the evolution of the perturbations also depend on the spatial scale under consideration as well as the background scale factor (which increase exponentially during generic models of inflation but decreases in contracting models)."

These perturbations, said Loeb, would be the source of any density variations observed by astronomers in the Universe today. How these variations were shaped can be determined by observing the background universe – specifically, whether it was expanding or contracting, which astronomers can distinguish between.

"In my metaphor, the scale factor of the universe is affecting the rate by which a tape is being pulled as the clock leaves tick marks on it," Loeb added. "The new signal we predict imprinted on how the level of non-uniformities in the universe change with spatial scale."



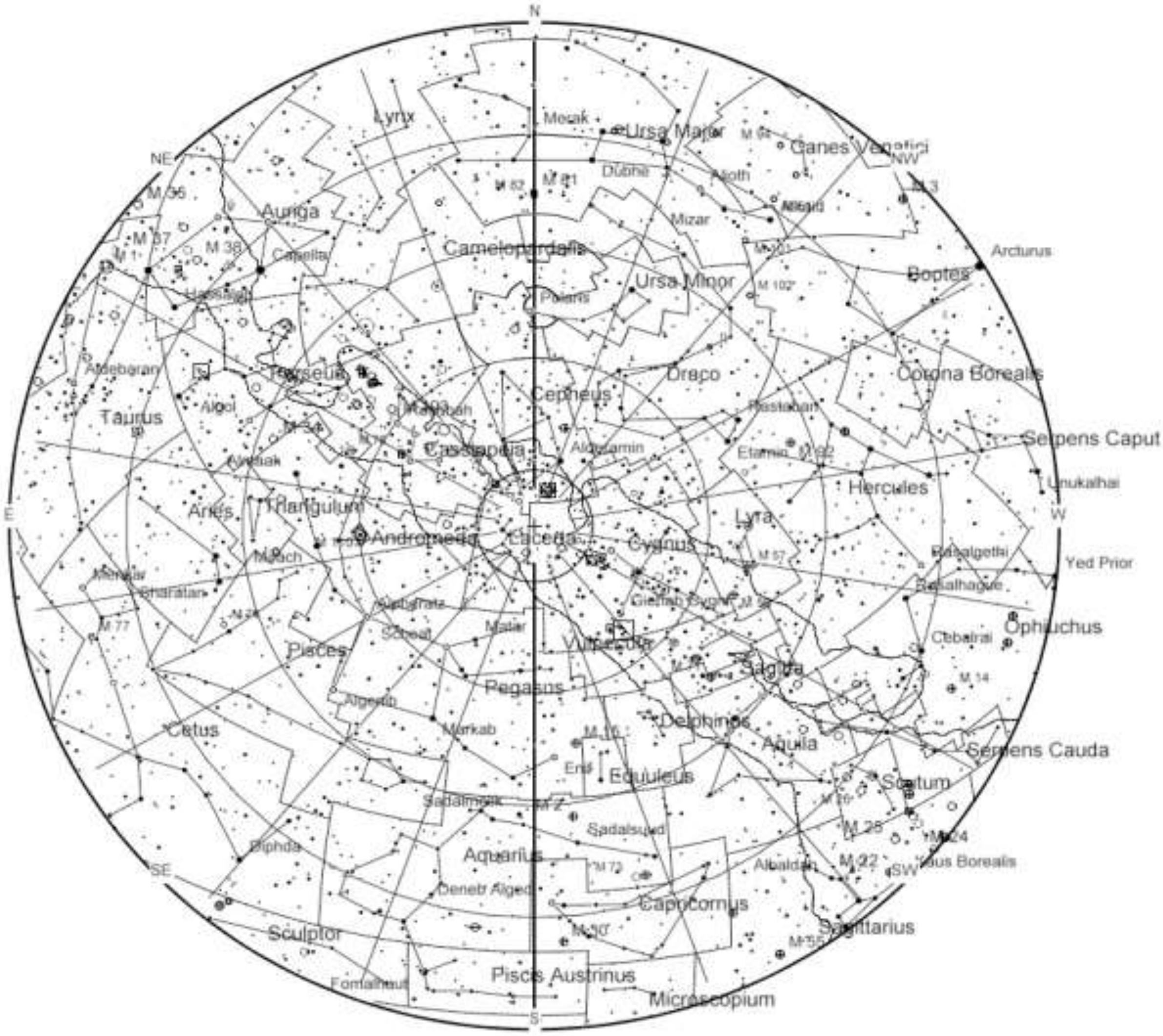
This illustration shows the evolution of the Universe, from the Big Bang on the left, to modern times on the right. Image: NASA

In short, Loeb and his colleagues identified a potential signal that could be measured using current instruments. These include those that have studying the Cosmic Microwave Background (CMB) – such as the ESA's *Planck* space observatory – and those that have been conducting galaxy surveys – the Sloan Digital Sky Survey, the VLT Survey Telescope, the Dragonfly telescope, etc.

In previous studies, it has been suggested that density variations in the primordial Universe could be detected by looking for evidence of non-Gaussianities, which are corrections for the Gaussian function estimate for the measurement of a physical quantity – in this case, the CMB. But as Loeb put it, these have yet to even be detected:

"The new oscillatory signal is in the power spectrum of primordial density perturbations (which is routinely measured from the cosmic microwave background [CMB] or galaxy surveys), whereas previous suggestions in the literature involved effects related to non-Gaussianities, which are much more challenging to measure (and were not detected as of yet). The results presented in our paper are very timely as expanded data sets are being collected by new observations of the CMB anisotropies and galaxy surveys."

Understanding how our Universe began is perhaps the most fundamental questions in science and cosmology. If by applying this method, alternative explanations for how the Universe began can be ruled out, it will bring us one step closer to determining the origins of time, space, and life itself. The questions "where do we come from?" and "how did it all begin?" may finally have a definitive answer!



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. This will be an excellent year to observe the Draconids because there will be no moonlight to spoil the show. 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 9 - **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 03:47 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.

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 nearly full 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 23 - **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.

October 24 - **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 16:46 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.

What You Can See This Month

By Chris Vaughan, SkySafari Software | October 1, 2018 07:00am ET

The night sky tonight and on any clear night offers an ever-changing display of fascinating objects you can see, from stars and constellations to bright planets, often the moon, and sometimes special events like meteor showers. Observing the night sky can be done with no special equipment, although a sky map can be very useful, and a good beginner telescope or binoculars will enhance some experiences and bring some otherwise invisible objects into view. You can also use astronomy accessories to make your observing easier, and use our Satellite Tracker page powered by N2YO.com to find out when to see the International Space Station and other satellites. Below, find out what's up in the night sky tonight (Planets Visible Now, Moon Phases, Observing Highlights This Month) plus other resources (Skywatching Terms, Night Sky Observing Tips and Further Reading).

The night sky is more than just the moon and stars, if you know when and where to look.

Credit: Karl Tate/SPACE.com

Monthly skywatching information is provided to Space.com by Chris Vaughan of Starry Night Education, the leader in space science curriculum solutions. .

Calendar of Observing Highlights

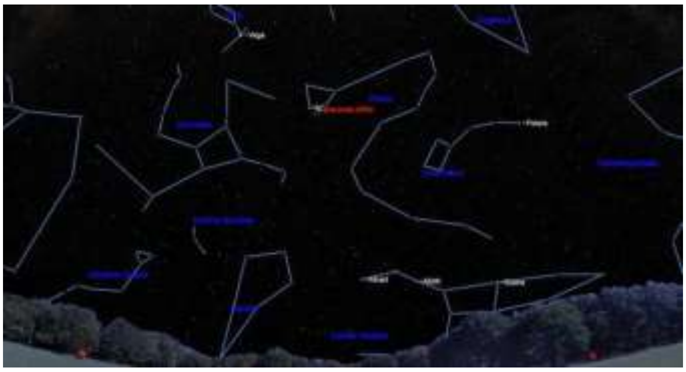
Tuesday, October 2 at 5:45 a.m. EDT — Last Quarter Moon

At its last quarter phase, the moon rises around midnight and remains visible in the southern sky all morning. At this phase, the moon is illuminated on its western side, towards the pre-dawn sun. Last quarter moons are positioned ahead of the Earth in our trip around the sun. About 3½ hours later, Earth will occupy that same location in space. After this phase, the waning moon traverses the last quarter of its orbit around the earth, on the way to new moon.

Thursday, October 4 pre-dawn — Moon Buzzes the Beehive

When the waning crescent moon rises in the early hours of Thursday, October 4, it will be located less than 2 degrees to the right of the large open star cluster known as the Beehive and Messier 11 in Cancer. Minimum separation will occur at 5 a.m. EDT. At that time, the moon will be 1 degree to the cluster's lower right, and both objects will fit within the field of view of a telescope at low magnification (orange circle).

Monday, October 8 — Draconids Meteor Shower Peaks

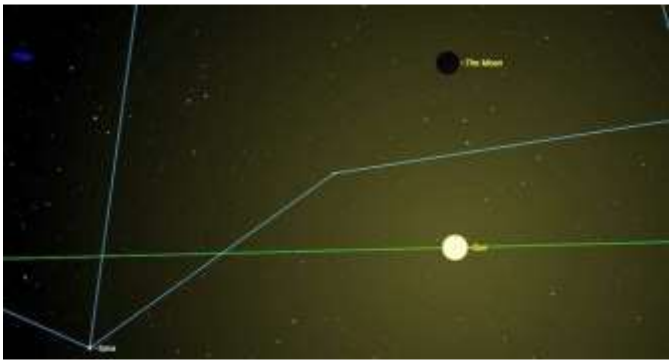


The annual Draconids Meteor Shower will peak overnight on the night of Monday, October 8. This shower, generated by debris dropped by Comet 21P/Giacobini-Zinner, usually delivers relatively few meteors. But it has occasionally been much more prolific. The best time to watch for Draconids will be after dusk, when the radiant in Draco is high in the northern sky.

Monday, October 8 pre-dawn — Morning Zodiacal Light for Mid-Northern Observers

During moonless periods in October and October annually, the steep morning ecliptic favors the appearance of the zodiacal light in the eastern sky for about half an hour before dawn. This is reflected sunlight from interplanetary particles concentrated in the plane of the solar system. During the two weeks starting just before the new moon on October 8, look east below the stars of Cancer for a broad wedge of faint light rising from the horizon and centered on the ecliptic (marked by green line). Don't confuse it with the Milky Way, which is sitting further to the southeast.

Tuesday, October 8 at 11:47 p.m. EDT — New Moon

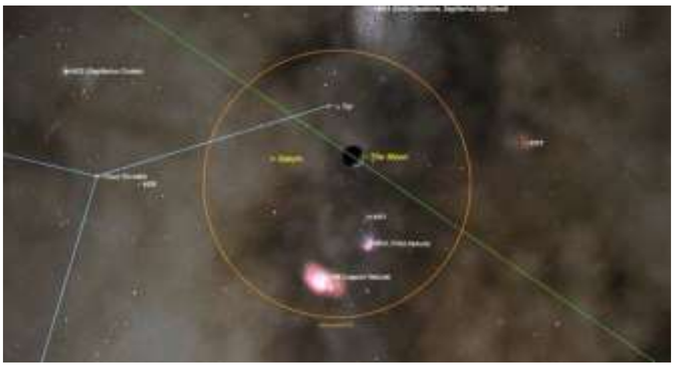


At its new phase, the moon is travelling between Earth and the sun. Since sunlight can only reach the far side of the moon, and the moon is in the same region of the sky as the sun, the moon will be completely hidden from view.

Thursday, October 11 evening — Young Moon meets Jupiter

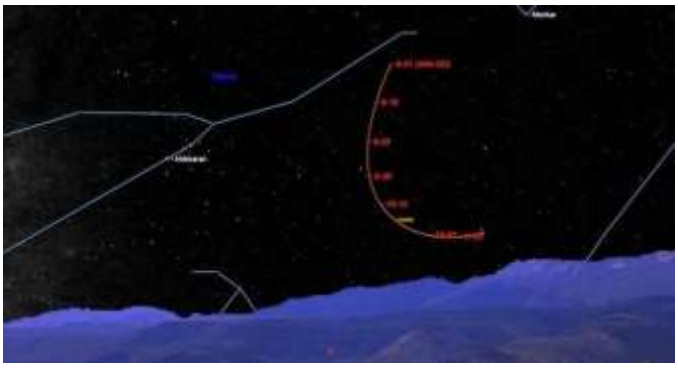
Low in the southwestern sky for a short period after sunset on Thursday, October 11, the young crescent moon will sit 3 degrees to the lower right of the very bright planet Jupiter. The pair of objects will be visible together in the field of view of binoculars (orange circle) until they set shortly after 8 p.m. local time.

Sunday, October 14 evening — Moon Passes Saturn



After dusk in the southwestern evening sky on Sunday, October 14, the waxing crescent moon will sit less than 2 degrees to the right of Saturn. The pair of objects will be visible together in the field of view of binoculars (orange circle) and will set at about 10:30 p.m. local time. Over the course of the evening, the moon's eastward orbital motion (green line) will carry it past Saturn. Their closest approach of 0.75 degrees, which occurs at 04:00 GMT, will be visible to observers in western North America.

Tuesday, October 16 overnight — Juno Reverses Direction



On Tuesday, October 15, the main belt asteroid designated (3) Juno will cease its regular eastward orbital motion (red path) through the stars and commence a westward retrograde loop that will last until late December. Look for the magnitude 7.9 object in the eastern evening sky among the stars of southern Taurus.

Credit: Starry Night software

On Tuesday, October 15, the main belt asteroid designated (3) Juno will cease its regular eastward orbital motion (red path) through the stars and commence a westward retrograde loop that will last until late December. Look for the magnitude 7.9 object in the eastern evening sky among the stars of southern Taurus.

Tuesday, October 16 — First Quarter Moon

After the moon has completed the first quarter of its orbit around Earth, the relative positions of the Earth, sun, and moon cause us to see it half-illuminated - on its eastern side. A first quarter moon always rises around noon and sets around midnight local time, so it is also visible in the afternoon daytime sky. The evenings around first quarter are the best times to see the lunar terrain when it is dramatically lit by low-angled sunlight.

Wednesday, October 17 evening — Moon Hops over Mars

In the southern sky on the evening of Wednesday, October 17, the first quarter moon will be positioned about 6 degrees to the right of Mars. From dusk until they set at around 1 a.m. local time, the moon's eastward orbital motion (green line) will carry it towards the Red Planet. The following evening, the moon will appear a similar distance from Mars, but now on the left side of the planet.

Sunday, October 21 pre-dawn — Orionids Meteor Shower Peak

The annual Orionid meteor shower, composed of debris from repeated passages of Comet Halley, runs from September 23 to November 27. It peaks between midnight and dawn on Saturday, October 21 under a dark moonless sky. At that time the sky overhead is moving directly into the densest region of the particle field, producing 10-20 fast meteors per hour. The meteors can appear anywhere in the sky, but will be travelling away from the constellation of Orion.

Tuesday, October 23 all night — Uranus at Opposition

Uranus will reach opposition on October 23, when it will be brightest (magnitude 5.7) and closest to Earth for the year and visible all night. But due to the presence of the nearly full moon, observers will have better luck seeing Uranus several nights ahead or after opposition night. During autumn this year, the blue-green planet will be moving retrograde westwards towards the two fishes of Pisces.

Tuesday, October 23 at 8:19 p.m. — Algol at Minimum Brightness

The "Demon Star" Algol in Perseus is among the most accessible variable stars for beginner skywatchers. Its naked-eye brightness dims noticeably for about 10 hours once every 2 days, 20 hours, and 49 minutes because a dim companion star orbiting nearly edge-on to Earth crosses in front of the much brighter main star. On Tuesday, October 23 at 8:19 p.m. EDT, Algol will reach its minimum brightness of magnitude 3.4. At that time, it will sit partway up the northeastern horizon. By 1:19 a.m. EDT, it will be approaching the zenith and will have brightened to its usual magnitude of 2.1.

Wednesday, October 24 — Full Hunter's Moon

The full moon of October, traditionally called the Hunter's Moon, Blood Moon, or Sanguine Moon, always shines in or near the stars of Cetus and Pisces. Since it's opposite the sun on this day of the lunar month, it rises at sunset and sets at sunrise.

Friday, October 26 over night — Moon Crosses the Bull

Overnight on Friday, October 26, the waning gibbous moon will approach and then pass through the Hyades star cluster, the stars that form the triangular face of Taurus the bull. The moon will enter the cluster at approximately 3 a.m. EDT. By sunset in the Eastern time zone, the moon will be central. Observers farther west will be able to see the moon pass only 0.75 degrees above Aldebaran, Taurus' brightest star at about 8 a.m. Pacific time. This is also an opportunity to look for Aldebaran in daylight using the nearby moon as a guide.

Sunday, October 28 after sunset — Mercury and Jupiter Meet

Very low in the southwestern sky after sunset on Sunday, October 28, bright Jupiter will sit 3 degrees above much dimmer Mercury. The pair of planets will be visible together for several evenings surrounding that date. Mercury will set first at about 7 p.m. local time.

Wednesday, October 31 midnight to dawn — Moon Approaches the Beehive

For the second time this month, the moon will pass close to the Beehive Star cluster in Cancer. This time, the orbital motion of the last quarter moon (green line) will slowly carry it towards the cluster – starting 6 degrees to the upper right of the cluster when it rises after midnight, and closing to within half that distance as the dawn twilight begins.

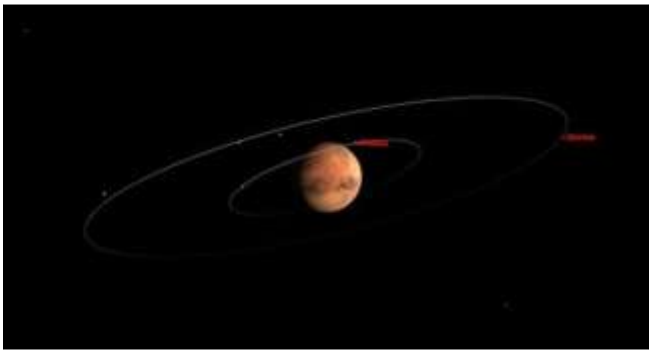
Wednesday, October 31 at 12:40 p.m. EDT — Last Quarter Moon Again

Because lunar phases repeat every 29.5 days, from time to time a phase that occurs in the opening days of a calendar month can repeat at the month end. At its last quarter phase, the moon rises around midnight and remains visible in the southern sky all morning. At this phase, the moon is illuminated on its western side, towards the pre-dawn sun.

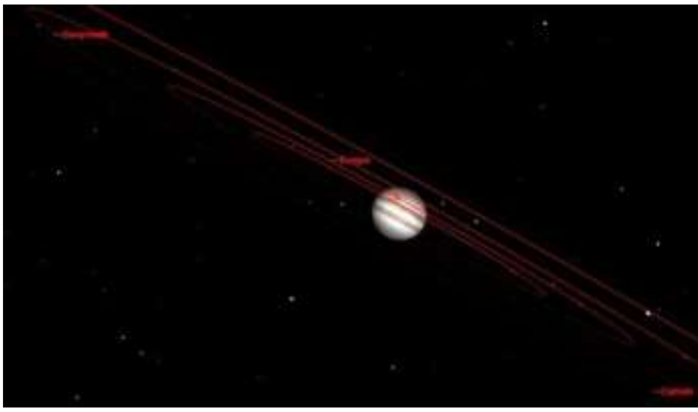
Planets

Following its conjunction with the sun in late September, **Mercury** will spend October in the western evening sky in an apparition that will be a poor one for mid-northern latitude observers, but very good for Southern Hemisphere observers. Viewed through a telescope during October, Mercury's disk will exhibit a phase that will continuously wane from nearly fully illuminated to 72% full. During the month, the planet's apparent disk diameter will slowly increase.

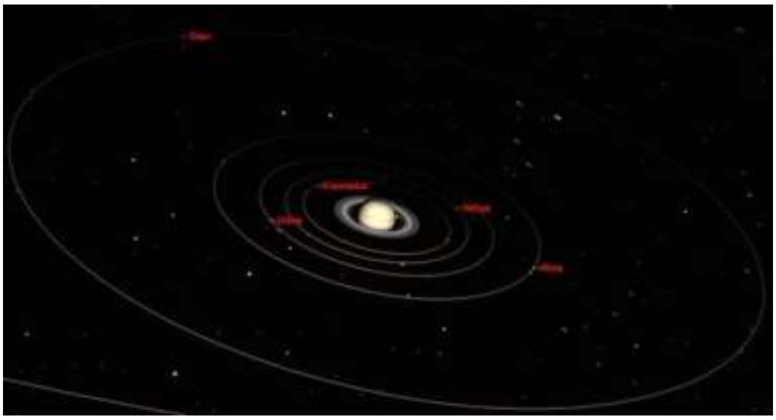
Venus' long evening apparition of 2018 will end as October begins. The very bright inner planet (visual magnitude -4.75) will only be visible during the first week of October, when it will set in the southwestern sky only half an hour after the sun. In a telescope,, it will exhibit a waning crescent that grows in apparent size as the planet moves towards Earth. For the rest of October, Venus will be too close to the sun for observing, passing below the sun in inferior conjunction on October 26. At month's end, Venus will enter the eastern pre-dawn sky.



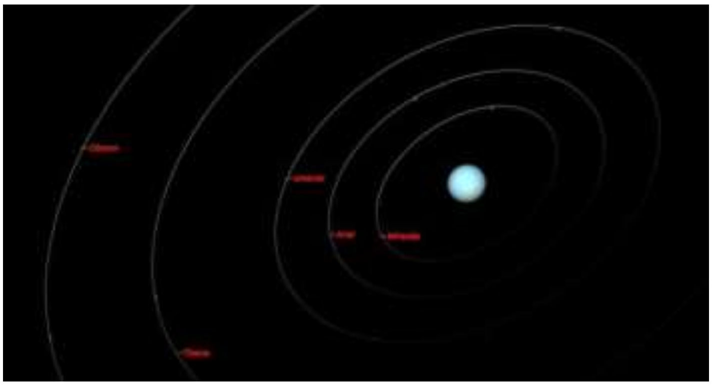
Mars, well positioned for viewing all month, will spend October moving eastward through the stars of central Capricornus. It will be relatively low in the southern evening sky and set after 1 a.m. local time. During the month, as Earth pulls away from the Red Planet, Mars will remain a bright reddish naked-eye object, but its visual brightness will diminish from magnitude -1.3 to -1.5. Meanwhile, the planet's apparent disk diameter will decrease from 15.6 arc-seconds to 11.9 arc-seconds. On the evenings of Wednesday, October 17 and Thursday, October 18, the waxing gibbous moon will land 5.5 degrees to the right and left of Mars, respectively.



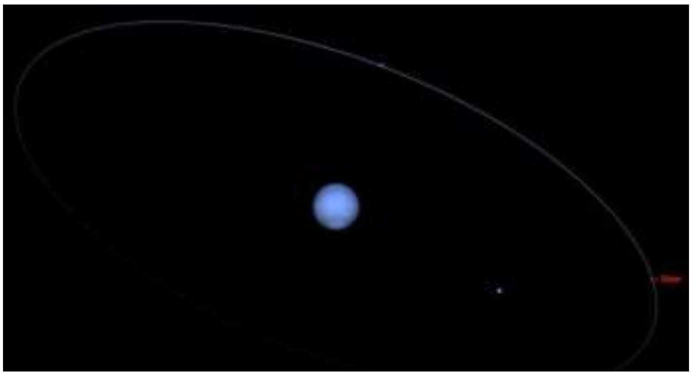
The available time for observing **Jupiter** will shorten considerably during October. The very bright planet (visual magnitude -1.8) will be positioned low in the southwestern evening sky all month. It will be moving eastward through the stars of central Libra, pulling away from the nearby bright double star Zubenelgenubi. Jupiter will set at about 8:45 p.m. local time on October 1 and at 7 p.m., in twilight, at month's end. On Thursday, October 11, the young crescent moon will sit 3 degrees to the lower right of Jupiter. The pair of objects will be visible together in the field of view of binoculars.



Saturn will be visible during October as a medium-bright (visual magnitude 0.5), yellowish object in the lower part of the southern evening sky. It will be moving slowly eastward within the Milky Way, to the upper right of the stars that form Sagittarius' teapot-shaped asterism. All month long, the planet will be positioned only a few degrees to the upper left of two fine deep sky objects – The Trifid Nebula and the Lagoon Nebula. Saturn's rings, which subtend an angular size of about 37 arc-seconds, continue to be well open because the planet's northern pole is tilted roughly sunward. On the evening of Sunday, October 14, the waxing crescent moon will sit less than 2 degrees to the right of Saturn.



Blue-green **Uranus** (magnitude 5.7) will spend October moving slowly retrograde westward among the stars of western Aries. On October 1, it will sit less than 3.5 degrees to the left of the naked-eye star Omicron (o) Piscium, closing to within 2.5 degrees left of that star at month end. Uranus will be observable all night after rising in the eastern sky after 9 p.m. local time. The planet will reach opposition, its closest approach to Earth and its brightest and largest appearance on October 23.



As October opens, blue-tinted **Neptune** will be recently past opposition, leaving it visible all night, and nearly at its largest and brightest (magnitude 7.8) for 2018. It will spend October moving retrograde westward through the stars of eastern Aquarius - shifting slowly toward that constellation's naked-eye star, Hydor (Lambda (λ) Aquarii). In early October, the planet will sit approximately midway between Hydor and the slightly fainter star Phi (φ) Aquarii. At month end, it will be 2 degrees to the left of Hydor.

Skywatching Terms

Gibbous: Used to describe a planet or moon that is more than 50 percent illuminated.

Asterism: A noteworthy or striking pattern of stars within a larger constellation.

Degrees (measuring the sky): The sky is 360 degrees all the way around, which means roughly 180 degrees from horizon to horizon. It's easy to measure distances between objects: Your fist on an outstretched arm covers about 10 degrees of sky, while a finger covers about one degree.

Visual Magnitude: This is the astronomer's scale for measuring the brightness of objects in the sky. The dimmest object visible in the night sky under perfectly dark conditions is about magnitude 6.5. Brighter stars are magnitude 2 or 1. The brightest objects get negative numbers. Venus can be as bright as magnitude minus 4.9. The full moon is minus 12.7 and the sun is minus 26.8.

Terminator: The boundary on the moon between sunlight and shadow.

Zenith: The point in the sky directly overhead.

Night Sky Observing Tips

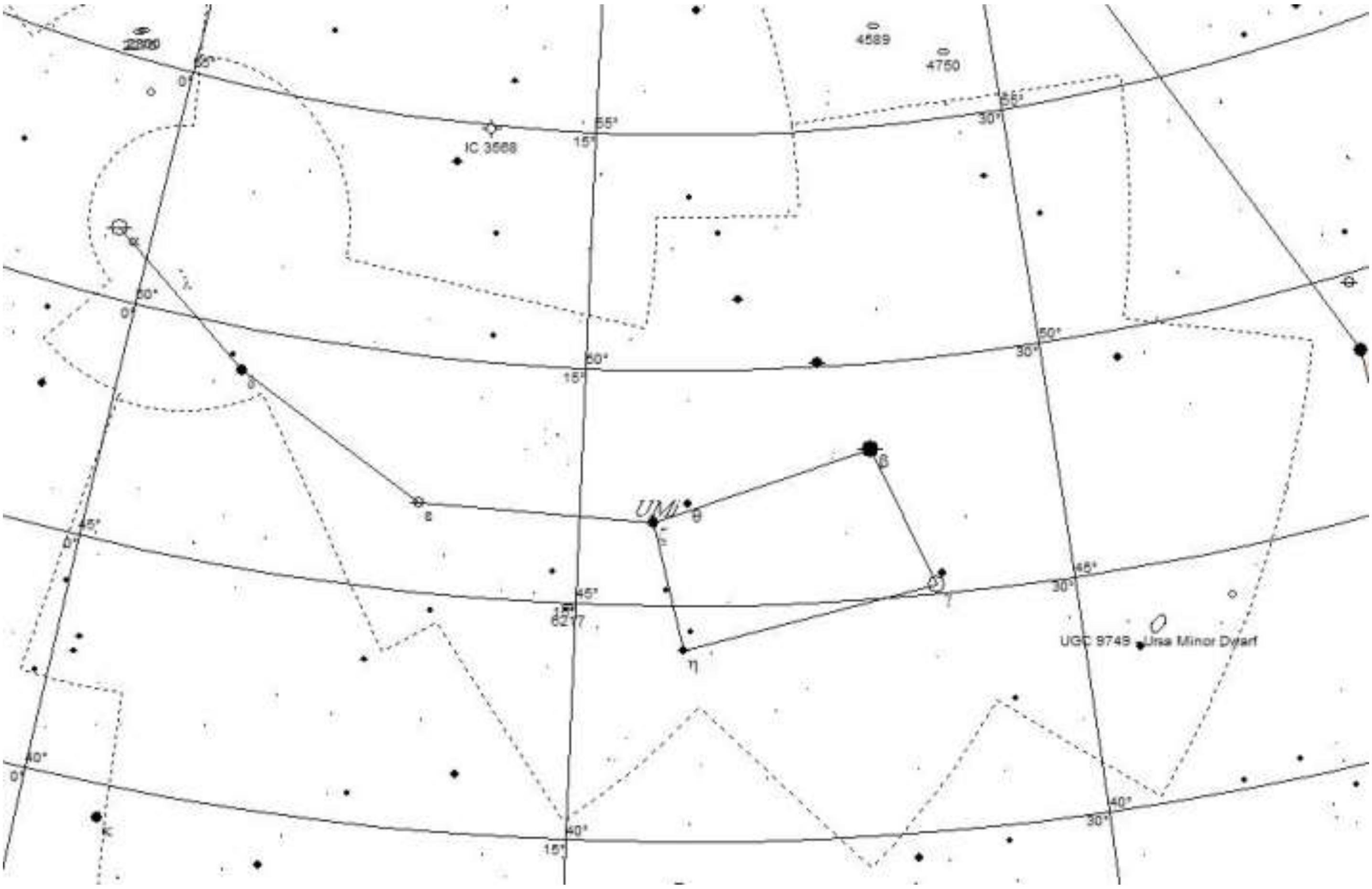
Adjust to the dark: If you wish to observe faint objects, such as meteors or dim stars, give your eyes at least 15 minutes to adjust to the darkness.

Light Pollution: Even from a big city, one can see the moon, a handful of bright stars and sometimes the brightest planets. But to fully enjoy the heavens — especially a meteor shower, the constellations, or to see the amazing swath across the sky that represents our view toward the center of the Milky Way Galaxy — rural areas are best for night sky viewing. If you're stuck in a city or suburban area, a building can be used to block ambient light (or moonlight) to help reveal fainter objects. If you're in the suburbs, simply turning off outdoor lights can help.

Prepare for skywatching: If you plan to be out for more than a few minutes, and it's not a warm summer evening, dress warmer than you think necessary. An hour of observing a winter meteor shower can chill you to the bone. A blanket or lounge chair will prove much more comfortable than standing or sitting in a chair and craning your neck to see overhead.

Daytime skywatching: When Venus is visible (that is, not in front of or behind the sun) it can often be spotted during the day. But you'll need to know where to look. A sky map is helpful. When the sun has large sunspots, they can be seen without a telescope. However, it's unsafe to look at the sun without protective eyewear. See our video on how to safely observe the sun, or our safe sunwatching infographic.

CONSTELLATIONS OF THE MONTH: Ursa Minor



Ursa Minor

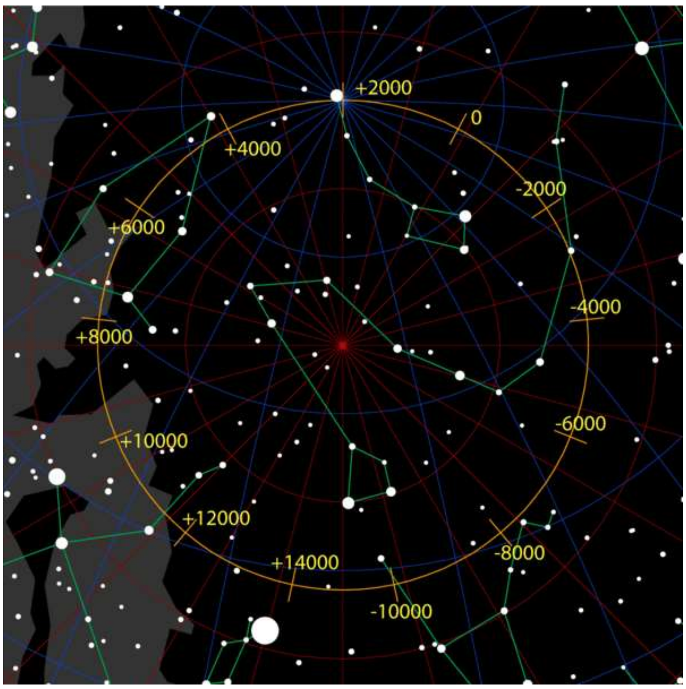
The northern circumpolar constellation of Ursa Minor was one of the 48 original constellations listed by Ptolemy, and remains one of the 88 modern constellations recognized by the IAU. Ursa Minor is currently the location of the north celestial pole, yet in several centuries, due the precession of the equinoxes, it will change. Ursa Minor covers 256 square degrees of sky and ranks 56th in size. It contains 7 main stars in its asterism and has 23 Bayer Flamsteed designated stars within its confines. Ursa Minor is bordered by the constellations of Draco, Camelopardalis and Cepheus. It is visible to all observers located at latitudes between +90° and ?10° and is best seen at culmination during the month of June.

There is one annual meter shower associated with Ursa Minor called the Ursids. Beginning on or about December 17th of each year, we encounter the meteoroid stream and activity can last through the end of December. The meteor shower itself is believed to be associated with Comet Tuttle and was probably discovered by William F. Denning during the 20th century. The peak date of activity occurs on December 22 during about a 12 hour window and you can expect to see about 10 meteors per hour on the average from a dark sky location.

In mythology, Ursa Minor is meant to represent a baby bear with a very long tail. Perhaps this springs from the “tale” of Kallisto and her son, who were placed in the sky as a bear and son. The tail is believed to be elongated from have been swung around the north star! In some forms of mythology, the seven stars of the Little Dipper were considered to be the Hesperides, daughters of Atlas… and it forms the “dragon’s wing” in yet other stories. While the “Little Dipper” asterism is a bit more difficult to recognize because its stars are more faint, once you do understand the pattern, you’ll always remember it. How? The star at the end of the little dipper handle is Polaris, the North Star. Polaris is easily identified by drawing a mental line through the two stars which form the end of the “bowl” of the Big Dipper and extending that line five times the distance.

Now, let’s take a look at Ursa Minor! While there are only a very few deep space objects here (and they require a large telescope) that doesn’t mean the constellation isn’t interesting. One handy thing to note is the stars themselves. The four stars in the “bowl” of the little dipper are unusual because they are of second, third, fourth and fifth stellar magnitude. While that might not seem like a big deal, it’s a great way to judge your sky conditions. What is the dimmest of the stars that you can see? Beta (B) is 2, Gamma (Y) is 3, Zeta (the squiggle) is 4 and the unmarked corner is Eta (n) and it is stellar magnitude 5.

Ready for the brightest star? Then say hello to Alpha (a) –



Polaris. Alpha Ursae Minoris is also known as the "North Star" and even as the Lodestar. While it might be 430 light -years from Earth, it is currently the closest star to the north celestial pole and a main sequence supergiant star. But don't just glance at it and walk away… Get out your telescope! In 1780, Sir William Herschel noticed something a little strange when he was looking at Polaris, and so will you… it has a companion star. That's right. Polaris is a binary star. Not only that… But when astronomers were examining Polaris B's spectrum, they noticed something else… You got it! Polaris B also has a spectroscopic companion, making this a tertiary star system. Are you ready for more? Then get this… Polaris A is also a Cepheid variable star! While its changes are very small (about 0.15 of a magnitude every 3.97 days), Polaris has brightened by 15% since we first began studying it and its variability period has lengthened by about 8 seconds each year since. That makes Polaris more than just another star… It's a super star!

Now aim your binoculars at Beta Ursae Minoris. Its name is Kochab and it is about 127 light years from our solar system. This orange giant star shines about 130 times more brightly than our own Sun. Somewhere around 3000 years ago, Kochab was once the pole star – but as Earth's precessional motion changed, so did its position. Even then it still wasn't quite as close as Polaris!

How about Gamma Ursae Minoris? Known as Pherkad, this spectral class A3 star is about 480 light years away and it is pretty special, too. Why? Because it's a Delta Scuti type variable star and its brightness varies by 0.05 magnitudes with a period of 3.43 hours. While you're not going to notice any change by just watching, image the power behind a star that shines 1100 times more luminous than the Sun, and possesses a radius 15 times larger!

Are you ready for Epsilon? Then get out the telescope, because 347 light year distant Epsilon is an eclipsing spectroscopic binary star. (Say that five times fast!) It is classified as a yellow G-type giant star with a mean apparent stellar magnitude of 4.21. In addition to light changes due to eclipses, the system is also classified as an RS Canum Venaticorum type variable star and its brightness varies from magnitude 4.19 to 4.23 with a period of 39.48 days, which is also the orbital period of the binary. The binary it orbited by a third component, Epsilon Ursae Minoris B, which is an 11th magnitude star, 77 arc seconds distant.

Now for Delta – the "8". Delta Ursae Minoris is about 183 light years away and goes by the strange name, Pherkard. While it isn't as grand as its mates, at least it is a white A-type main sequence dwarf star!

Last, but not least, is RR Ursae Minoris. You've got it… The double letter designation denotes a variable star. While changes are very small (4.73 at minimum and magnitude 4.53 at maximum) it's the period that counts here. The changes take period of 748.9 days to happen! This means that RR has been highly studied to make sure it doesn't have a spectroscopic companion – and so far none have been found.

ISS PASSES For September 2018 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start			Highest point			End		
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
02 Oct	-3.9	20:23:42	10°	W	20:27:01	90°	N	20:27:48	49°	E
02 Oct	-0.5	22:00:16	10°	W	22:00:28	11°	W	22:00:28	11°	W
03 Oct	-3.8	19:31:47	10°	W	19:35:06	85°	N	19:37:52	14°	E
03 Oct	-2.4	21:08:19	10°	W	21:10:32	36°	WSW	21:10:32	36°	WSW
04 Oct	-3.8	20:16:24	10°	W	20:19:42	72°	SSW	20:20:36	44°	SE
04 Oct	-0.4	21:53:12	10°	W	21:53:16	10°	W	21:53:16	10°	W
05 Oct	-3.8	19:24:28	10°	W	19:27:47	86°	S	19:30:40	13°	E
05 Oct	-2.1	21:01:04	10°	W	21:03:21	29°	WSW	21:03:21	29°	WSW
06 Oct	-3.1	20:09:04	10°	W	20:12:16	47°	SSW	20:13:28	31°	SSE
07 Oct	-3.5	19:17:06	10°	W	19:20:23	65°	SSW	19:23:37	10°	ESE
07 Oct	-1.6	20:54:02	10°	W	20:56:18	19°	SW	20:56:18	19°	SW
08 Oct	-2.2	20:01:47	10°	W	20:04:42	28°	SSW	20:06:31	17°	SSE
09 Oct	-2.7	19:09:42	10°	W	19:12:51	41°	SSW	19:15:59	10°	SE
09 Oct	-0.9	20:48:07	10°	SW	20:48:41	10°	SW	20:49:15	10°	SSW
10 Oct	-1.2	19:54:48	10°	W	19:56:58	16°	SW	19:59:07	10°	S
11 Oct	-1.7	19:02:25	10°	W	19:05:10	25°	SSW	19:07:55	10°	SSE
13 Oct	-0.8	18:55:33	10°	WSW	18:57:20	14°	SW	18:59:07	10°	S
27 Oct	-0.9	06:46:55	10°	S	06:48:54	15°	SE	06:50:54	10°	ESE
29 Oct	-1.8	05:37:52	10°	SSW	05:40:41	26°	SSE	05:43:30	10°	E
30 Oct	-1.4	04:47:21	14°	S	04:48:39	18°	SE	04:50:57	10°	E
30 Oct	-3.3	06:21:27	10°	WSW	06:24:41	61°	SSE	06:27:57	10°	E
31 Oct	-0.5	03:57:38	10°	ESE	03:57:38	10°	ESE	03:57:47	10°	ESE
31 Oct	-2.9	05:30:18	17°	SW	05:32:31	44°	SSE	05:35:41	10°	E
01 Nov	-2.3	04:40:27	30°	SSE	04:40:27	30°	SSE	04:43:20	10°	E
01 Nov	-3.8	06:13:21	10°	WSW	06:16:39	84°	S	06:19:56	10°	E
02 Nov	-0.4	03:50:30	12°	E	03:50:30	12°	E	03:50:50	10°	E
02 Nov	-3.7	05:23:10	34°	WSW	05:24:24	68°	SSE	05:27:40	10°	E
03 Nov	-2.3	04:33:08	36°	ESE	04:33:08	36°	ESE	04:35:22	10°	E
03 Nov	-3.8	06:05:48	14°	W	06:08:35	85°	N	06:11:53	10°	E
04 Nov	-3.9	05:15:42	57°	WSW	05:16:17	88°	S	05:19:36	10°	E
05 Nov	-1.7	04:25:33	28°	E	04:25:33	28°	E	04:27:16	10°	E
05 Nov	-3.9	05:58:13	18°	W	06:00:30	88°	N	06:03:48	10°	E
06 Nov	-4.0	05:08:02	81°	NW	05:08:09	84°	N	05:11:27	10°	E
07 Nov	-1.2	04:17:51	21°	E	04:17:51	21°	E	04:19:07	10°	E
07 Nov	-3.8	05:50:30	24°	W	05:52:19	76°	SSW	05:55:36	10°	ESE
08 Nov	-3.6	05:00:19	71°	E	05:00:19	71°	E	05:03:17	10°	E
08 Nov	-2.9	06:33:14	10°	W	06:36:18	37°	SSW	06:39:22	10°	SE
09 Nov	-0.8	04:10:07	16°	E	04:10:07	16°	E	04:10:55	10°	E
09 Nov	-3.5	05:42:47	31°	W	05:44:03	52°	SSW	05:47:15	10°	SE
10 Nov	-2.8	04:52:37	44°	SE	04:52:37	44°	SE	04:55:00	10°	ESE
10 Nov	-2.1	06:25:16	10°	W	06:27:51	22°	SW	06:30:27	10°	SSE

END IMAGES, OBSERVING AND OUTREACH

Following John Dartnell showing me the Canon G16 results for in camera star trails I thought I would give on a go. Unpromising sky and dew levels I gave it try out of my north facing upstairs window. Set it for 90 minutes run, and it took a series of 6 second pictures with a 1 second delay (automatically set by the camera) and here it also caught aircraft trails, a bright iridium flare and the passage of a couple of trains on the track behinf the house. Once you find, very easy, but you do have to download a manual from the internet to find it. Andy Burns

Wiltshire Astronomical Society	**Observing Sessions 2018 – 2019**	
Date	**Moon Phase (%)**	**Moonrise**
2018		
2nd November	Waning Crescent (25%)	After midnight
30th November	Waning Crescent (39%)	After midnight
28th December (6.30pm start)	Last Quarter (54%)	11.35 pm
2019		
21st January	Total Lunar Eclipse	Starts 03:30 am
25th January	Waning Gibbous (70%)	10.36 pm
22nd February	Waning Gibbous (84%)	9.31 pm
29th March	Waning Crescent (32%)	After midnight
26th April	Waning Gibbous (58%)	After midnight
24th May	Waning gibbous (75%)	After midnight

OUTREACH

Friday 9th November. Great Wishford School, nr Wilton. Afternoon and possible evening.

Tuesday 13th November Minety CofE Primary School. Afternoon and possible evening, weather permitting.