NWASNEWS

Volume23, Issue 10

June 2018

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

End of Season with Thanks.

From the position of Vice Chairman and editor of the newsletter can I take this opportunity to thank the the other members of the committee and some notable helpers for all they have done to keep the Wiltshire Astronomical Society flourishing through the past year.

Chairman Keith Bruton, speaker secretary Peter Chappell and treasurer Bob Johnston may be the more noticeable at our meetings, but behind the scenes and standing in for various roles we have had Debbie Crocker, Philip Proven looking after our hall bookings despite ill health occasionally grabbing him, the coffee machine that is Dave Buckle (he will understand the pun), observing session organisors Tony Vale and Jonathan Gale. Hopefully will add to this number at our AGM, with an opportunity to reassert our web presence???

But to all, and here I mean members too, thank you.

Also good to note that Peter Struve from Swindon Stargazers is on the road to recovery.

If you are getting away this summer, may I wish you bon vacance (happy holiday if you wanted Brexit), and dark clear skies wherever you go or stay.

For the early part of the summer with Moonless skies do watsh out for noctilucent clouds about 90 minutes to 2 hours before or after sunset or sunrise. If you watch for Capella and towards the horizon you may be lucky enough to catch the Noctilucent clouds (nlcs) that appear with an electric blue brightness in a dark blue sky.

When the sun is at minima is considered the best time to catch them.

Summer is also a great time to catch the most southerly part of our own Milky Way galaxy as it loops through the sky, through Cepheus, Cygnus, Aquilla, Scutum, Sagittarius and Scorpio. This is the broadest and brightest direction of the Milky Way, with the centre in Scorpio hidden by dust and stars. The dark molecule regions are fascinating and important parts of our galaxy. Occasionally these have enough circulation to compress enough to create more stars.

Plotting the stars by brightness (absolute) and colour gives us a great insight into the life of stars, and our speaker this month, Martin Griffiths will give us an insight into this life of stars tonight.

Clear Skies

Andy

Noctilucent clouds from 2016 in the pre dawn skies from the middle of Chippenham.
Looking north east, you can just begin to see a reddening in the sky before true dawn.

Andy Burns

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

Meetings 2015/2016Season.

NEW VENUE the Pavilion, Rusty Lane, Seend

Meet 7.30 for 8.00pm start

Date	Speaker	Title
5th Jun	Martin Griffiths	Understanding Stars +AGM.

2018/19 season

4th Sep: Andrew Lound, TBA

2nd Oct: Mary McIntyre, Creating Stunning Star Trails.

Martin Griffiths BSc. (First Class Honours) MSc. (Distinction) FRAS. FHEA.

Martin Griffiths is an enthusiastic science communicator, lecturer, writer and professional astronomer utilizing astronomy, history and science fiction as tools to encourage greater public understanding of science.

He was a founder member of NASA's Astrobiology Institute Science Communication Group, active between 2003-2006 and managed a multi-million pound ESF programme in Astrobiology for adult learners between 2003-2008. Martin has written and presented planetarium programmes for key stages 1, 2 and 3 and has been an adviser to several museum projects

Martin continues to promote cross-disciplinary links between science and culture that reflect his educational background and interests. He has written monographs on the science communication of the proto-feminist Margaret Cavendish, Duchess of Newcastle; and the 18th century scientist, assay master and political adviser Joseph Harris of Breconshire. He is also a regular contributor to the online science journal LabLit: the culture of science in fiction and fact. Recently he assisted the Brecon Beacons National Park in surveying the darkness of the night sky for their successful bid for the International Dark Sky Association's Dark Sky Reserve Status – the first such reserve in Wales.

Martin is a Fellow of the Royal Astronomical Society; a Fellow of the Higher Education Academy; a member of the British Astronomical Association; the Webb Deep-Sky Society; the Society for Popular Astronomy, The Astronomical Society of the Pacific and the Astronomical League. He is also a local representative for the BAA Campaign for Dark Skies. Martin broadcasts regularly on BBC Wales radio and has appeared on science programmes for the BBC, Einstein TV, Granada TV and the Discovery Channel. He is also a member of the Honourable Society of Cymmrodorion, dedicated to promoting the science, arts and literature of Wales.

He is now working for Dark Sky Wales in their outreach work to schools and adult learning groups. He has now written four books in the Springer Astronomy Series. And completed another book on the myths in the skies.

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)

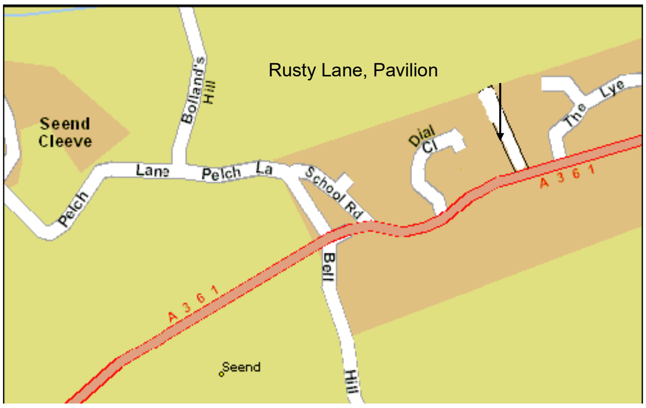
Philip Proven (Hall coordinator) Dave Buckle (Teas)

Peter Chappell (Speaker secretary)

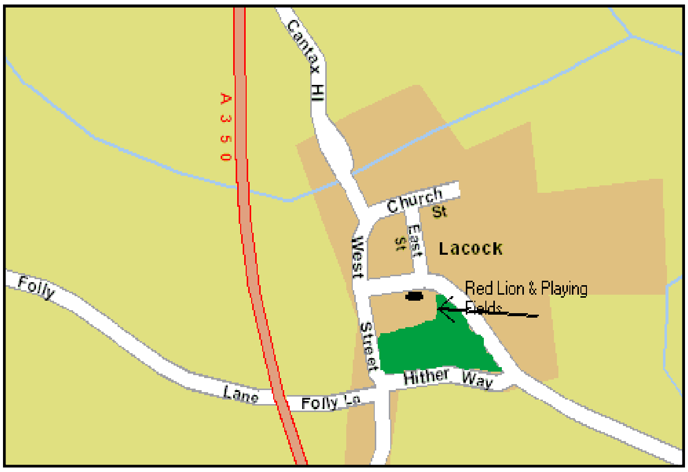
Nick Howes (Technical Guru)

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

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.

Pete, our chairman, recovering well

Our chairman, Peter Struve who had suffered another stroke, is now recovering quite well and attended our last club meeting.

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 15 June 2018
Programme: Owen Brazell - Galaxy Clusters

Summer Break: No meetings in July and August

Friday 21 September 2018
Programme: Dr. Chris Pearson: Galaxy Formation and Evolution

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 21 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
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Address: 3 Monkton Close, Park South, Swindon, SN3 2EU

Secretary: Dr Bob Gatten (PhD)
Tel Number: 07913 335475

Email: bob.gatten@ntlworld.com
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BECKINGTON ASTRONOMICAL SOCIETY

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

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

Our Committee for 2016/2017 is

Steve Hill-----------Chairman- 01761 435663

John Ball-----------Vice Chairman- 01373 830419

………….john@abbeylands1.freeserve.co.uk

Sandy Whitton---- Secretary-07974-841239

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Jacky Collenette---Treasurer… collenettejacqueline@yahoo.co.uk

Mike Witt---------- Membership-……… mjwitt@blueyonder.co.uk.

John Dolton------ Committee…. member@jdolton.freeserve.co.uk

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.

15th June	Annual General Meeting *Member Talks*	

Dear Herschellians,

WHS Programme May - July (A full description will be sent out about a week before each event)

Fri 13 Jul 18	Dr Daniel Batcheldor	Paler Blue Dots: Technology Developments on ISS for

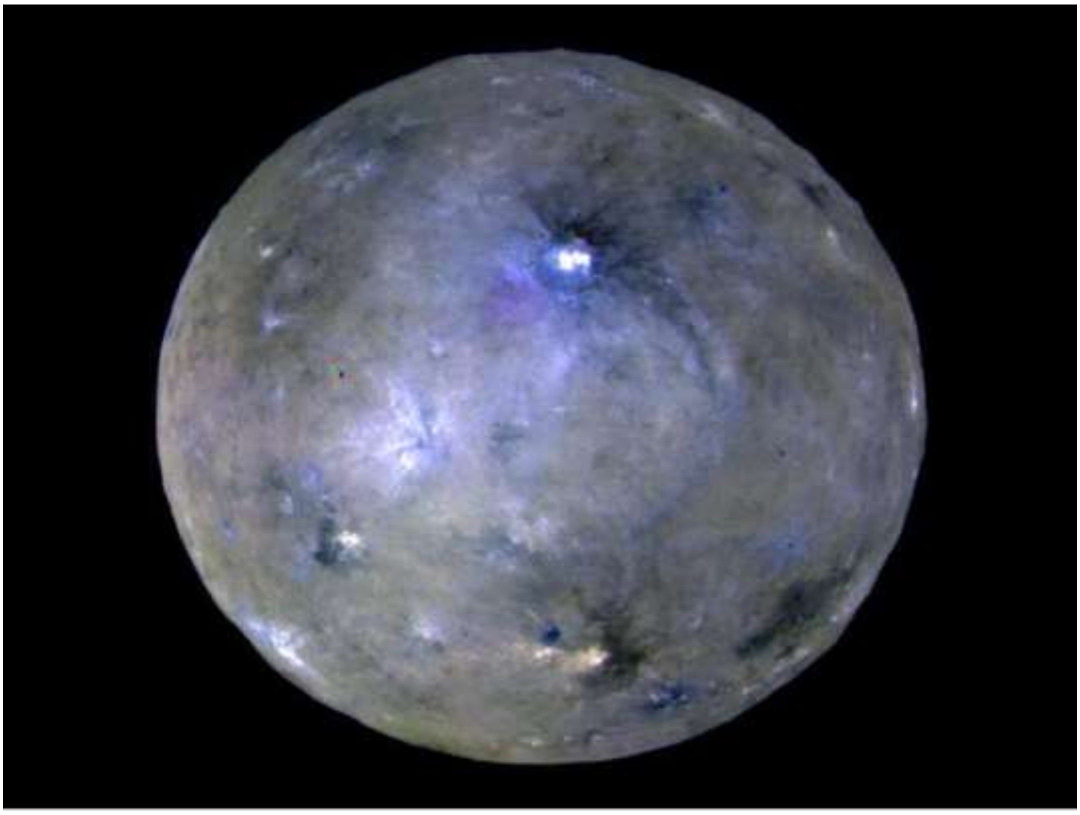
What Is the Asteroid Belt?

By Linda Hermans-Killiam

There are millions of pieces of rocky material left over from the formation of our solar system. These rocky chunks are called asteroids, and they can be found orbiting our Sun. Most asteroids are found between the orbits of Mars and Jupiter. They orbit the Sun in a doughnut-shaped region of space called the asteroid belt.

Asteroids come in many different sizes—from tiny rocks to giant boulders. Some can even be hundreds of miles across! Asteroids are mostly rocky, but some also have metals inside, such as iron and nickel. Almost all asteroids have irregular shapes. However, very large asteroids can have a rounder shape.

The asteroid belt is about as wide as the distance between Earth and the Sun. It's a big space, so the objects in the asteroid belt aren't very close together. That means there is plenty of room for spacecraft to safely pass through the belt. In fact, NASA has already sent several spacecraft through the asteroid belt!



Caption: This image captured by the Dawn spacecraft is an enhanced color view of Ceres, the largest object in the asteroid belt. Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

The total mass of objects in the asteroid belt is only about 4 percent the mass of our Moon. Half of this mass is from the four largest objects in the belt. These objects are named Ceres, Vesta, Pallas and Hygiea.

The dwarf planet Ceres is the largest object in the asteroid belt. However, Ceres is still pretty small. It is only about 587 miles across—only a quarter the diameter of Earth's moon. In 2015, NASA's Dawn mission mapped the surface of Ceres. From Dawn, we learned that the outermost layer of Ceres—called the crust—is made up of a mixture of rock and ice.

The Dawn spacecraft also visited the asteroid Vesta. Vesta is the second largest object in the asteroid belt. It is 329 miles across, and it is the brightest asteroid in the sky. Vesta is covered with light and dark patches, and lava once flowed on its surface.

The asteroid belt is filled with objects from the dawn of our solar system. Asteroids represent the building blocks of planets and moons, and studying them helps us learn about the early solar system.

For more information about asteroids, visit: https://spaceplace.nasa.gov/asteroid

MEMBERS VIEWING LOGS and IMAGES

Viewing Log for 11th of May

This is my first viewing log from another country, if I said my latitude was 13° 06' North and 59° 37' West would you guess where I was? Well it happens I was in the eastern part of the West Indies on the island of Barbados.

From our apartment it was about a three minute walk to get to Gibbs Beach, this is where I would be starting my viewing session, as during the week once the Sun had set I found Venus pretty quickly followed by other stars and constellations, some which I knew and others I did not know, especially south of Canis Major's bright star, namely Sirius. As I was on holiday I was limited to what I could bring with me, so it would be my William Optic's 80 mm refractor with Orion II zoom eye piece on a Manfrotto tripod. The tripod I normally just use for camera work but it is quite strong and can take the 80 mm, just? Gibbs Beach is about 2/3 of the way up the west coast from Bridgetown and on the calmer side of the island for wind; the eastern side has the trade wind which blows most of the time. I had my telescope and tripod set up by 19:17 (local time) on the beach with a pleasant 26 ° in temperature but the air was fairly humid. My first target was Venus which was starting to set over the black sea. With no light pollution out on the sea I could not make out where the sea stopped and the sky started, it was that dark! Orion was still up, so my next target was M 42 and M 43, both of these did not look at good as I have seen them at home, this was due to the equipment I was using, less aperture and magnification. Going south from Sirius you come across the star Canopus (2nd brightest star in the night sky after Sirius) which was less than 10 ° above the horizon, I think? Back to Orion again and look at the belt stars of Alnitak, Alnilam & Mintaka (from the east), could not make out M 78 just above them. Into Taurus and look at the red giant of Aldebaran followed by another red giant in Betelgeuse in Orion. On to Sirius before looking south of Sirius and an area I did not know, as I did not bring an atlas with me all I could do was look at the area and go from there. By now it was 20:05 and time to go back to our apartment and view from beside the pool.

Started again at 20:20 and could see the asterism of the Southern Cross in Crux just above the tree line. One of my favourite Open Cluster's (O C) is the Jewel Box just to the east of the cross. After a bit of scanning I picked it up and had a good look at it, this O C was discovered by John Herschel. The Coal Sack nebula not far below the Jewel Box I could not really make out as the trees where blocking some of it? Next target was the double star Acrux, part of the Southern Cross and brightest star in the constellation. By now Jupiter was well up in the eastern sky, so I turned my telescope around and viewed the largest planet in the Solar System, the four main Moons had one to the west (Io) and three to the east (Europa, Ganymede & finally Calisto) of the planet, could also make out the two main weather belts but nothing else (I did finally manage to see the Great Red Spot from the Harry Bayley observatory in Bridgetown a couple of nights later but I was looking thru a 16 inch Meade LX200!). I had been looking for Omega Centauri (brightest Globular Cluster (G C) in the night sky) for some time with no luck, so I transferred the camera on to the tripod and started taking pictures of the Crux area and in one of the pictures I managed to bag the G C I had been looking for J. So without moving the tripod I refitted the telescope and had a look, after a while I managed to find it, it looked good but not as good as M 13 in Hercules as I have seen it, again I put this down to the equipment I was using, if I had my Meade LX90 with me I guess it would probably blow me away? Final target for the evening was Rigil Kentaurus, alpha star and 3rd brightest star in the night sky in the constellation of Centaurus.

This was our fifth night in country and we still had not fully recovered from the jet lag, we were normally going to bed by around 21:00 and waking up by 5:00 and just hanging around for a while before doing anything, by 21:47 I had had enough! Barbados was starting to enter its wet season, so I had a battle with clouds most of the evening, not one night while we were there was it totally clear night. Had lots of what I call sucker gaps nights, get you outside only for the clouds to roll over. Either way it was a nice pleasure to be able to see southern gems we cannot see from the UK, my next trip down this way will be next April as Mrs C would like to visit another island out this way?

Clear skies if you are doing any viewing over the summer.

Peter Chappell

Hi Andy,

Here images for the June WAS Newsletter.

17/05/2018

Perigee 6% Crescent Moon

Canon SX50HS Bridge Camera

F8, ISO 400, 1/25 sec

2400mm (50x Optical and 50 x Digital)

20/05/2018 ISS pass between 23:43:30 – 23:49:54

ISS arching over Jupiter and below Arcturus

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

I had light pollution on my left from Swindon and Royal Wootton Bassett and waxing 34% lit Moon to my right so I had to use short exposures to avoid over exposing. I settled on F3.5, 4 Sec, ISO 3200.

I did think of using a star tracker but the tracker would be tracking East to West and the ISS SSW to SSE during the pass so I was not sure how this pan out for the final image!

The time for the complete pass was over six minutes so when I layered the 59 images I had star trails in the background. To eliminate the star trails I used one image as a layer mask processing in GIMP 2.

Clear Skies,

John Dartnell

Andy Burns images: All taken from Chippenham.

The crescent moon (2days) with Venus top right and Mercury bottom right. 20 images stacked.

Caldwell 32, ngc 4651 right and ngc4565 the Hockey stick galaxies in Coma Berenices.

Caldwell 38, ngc4565 Needle galaxy in Coma B.

SPACE NEWS FOR JUNE

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

A Tiny Asteroid Just Hit Earth, Sparking a Fireball Over South Africa

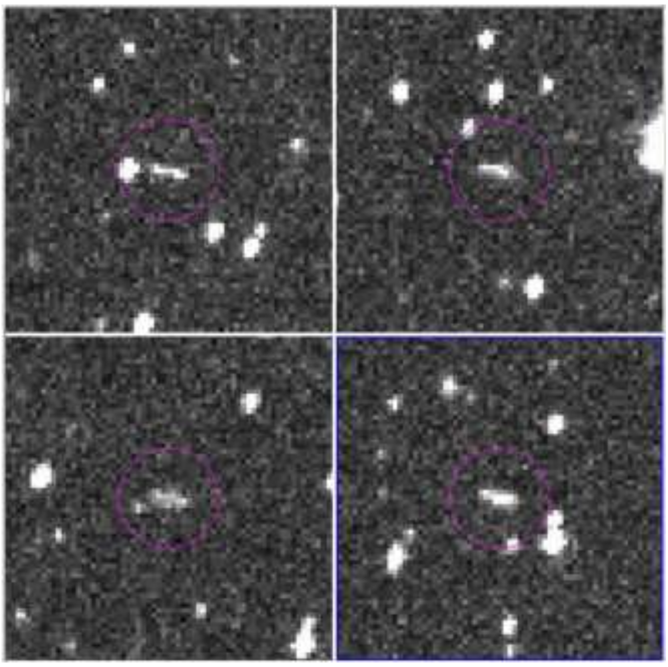
Scientists discovered the asteroid, called 2018 LA, early Saturday. After a closer look at the space rock's trajectory, it "was determined to be on a collision course with Earth, with impact just hours away," NASA officials said in a statement. The asteroid hit Earth's atmosphere over the southern African nation of Botswana at 12:44 p.m. EDT (1644 GMT) while hurtling down at a whopping 38,000 mph (61,155 km/h). That's 10 miles (or 17 kilometers) every second!

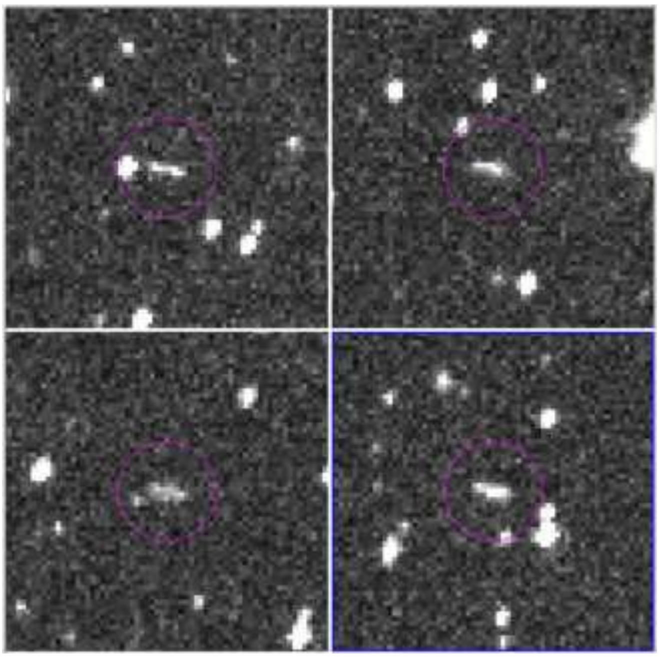
Astronomers with the Catalina Sky Survey near Tucson, Arizona, were the first to discover the asteroid. The space rock was very faint, with observations suggesting it was just 6 feet (2 meters) across — small enough to burn up completely during its fiery plunge through the atmosphere, NASA officials said. [Asteroid Threat: Potentially Dangerous Space Rocks in Pictures]

"The discovery of asteroid 2018 LA is only the third time that an asteroid has been discovered to be on an impact trajectory," Paul Chodas, manager of the Center for Near-Earth Object Studies (CNEOS) at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, said in the statement. "It is also only the second time that the high probability of an impact was predicted well ahead of the event itself."

The asteroid's fiery demise was caught on camera by spectators, who later posted their footage to YouTube. In one video, from a farm between Ottosdal and Hartebeesfontein in South Africa, the asteroid appears as a brilliant streak that flares up into a spectacular fireball on the horizon.

Asteroid 2018 LA was nearly as far away as the moon (which is typically about 239,000 miles, or 384,600 km, from Earth) when it was discovered on Saturday, NASA officials said. It looked like little more than a streak in long-exposure images by the Catalina telescope.





These images show the discovery of asteroid 2018 LA by the Catalina Sky Survey on June 2, 2018. The asteroid hit Earth 8 hours after these images were taken, burning up in Earth's upper atmosphere over Botswana, Africa.

Credit: NASA/JPL-Caltech/CSS-Univ. of Arizona

"This was a much smaller object than we are tasked to detect and warn about," Lindley Johnson, NASA's planetary defense officer, said in the statement. "However, this real-world event allows us to exercise our capabilities and gives some confidence our impact prediction models are adequate to respond to the potential impact of a larger object."

Catalina Sky Survey astronomers reported the asteroid finding to the Minor Planet Center in Cambridge, Massachusetts, which managed to calculate a preliminary trajectory for the asteroid. That trajectory plot was the first hint that 2018 LA could hit Earth.

The Minor Planet Center then reported the asteroid to CNEOS. JPL's automated Scout system, which tracks asteroids, confirmed 2018 LA was on a collision course with Earth and sent observation alerts out to asteroid observers to try spotting it.

While this isn't the first time a small asteroid has been spotted just before it hit Earth, it certainly isn't that common. Only two other instances come to mind, according to JPL.

On Oct. 7, 2008, the 13-foot (4 m) asteroid 2008 TC3 hit Earth over northern Sudan. That asteroid was spotted 19 hours before impact, enough time for scientists to plot a precise trajectory for the falling space rock. Later expeditions used that trajectory to find meteorite fragments of 2008 TC3.

The second event occurred Jan. 1, 2014, when the asteroid 2014 AA was spotted just a few hours before it fell over the Atlantic Ocean.

All three asteroids were discovered by the Catalina Sky Survey while astronomer Richard Kowalski was overseeing observations, NASA officials said. NASA scientists and astronomers around the world regularly observe the sky for any signs of potentially dangerous asteroids that could pose an impact threat to Earth.

Neither asteroid 2018 LA nor its two predecessors were large enough to cause the type of damage seen in 2013, when an asteroid about 56 feet (17 m) wide exploded over the Russian city of Chelyabinsk. The fireball shattered windows and damaged thousands of buildings, leaving more than 1,200 people injured.

Email Tariq Malik at tmalik@space.com or follow him @tariqjmalik. Follow us @Spacedotcom, Facebook and Google+. Original article on Space.com.

Pluto has “Sand Dunes”, but Instead of Sand, it’s Grains of Frozen Methane

Article written: 4 Jun , 2018
Updated: 4 Jun , 2018

by Matt Williams

In July of 2015, the *New Horizons* mission made history when it conducted the first flyby in history of Pluto. In the course of conducting its flyby, the probe gathered volumes of data about Pluto’s surface, composition, atmosphere and system of moons. It also provided breathtaking images of Pluto’s “heart”, its frozen plains, mountain chains, and it’s mysterious “bladed terrain”.

These strange features showed people for the first time how radically different the surface of Pluto is from Earth and the other planets of the inner Solar System. But strangely, they also showcased how this distant world is also quite similar to Earth. For instance, in a new study, a team of researchers working on the images from the *New Horizons* mission noticed “dunes” on the surface of Pluto that resemble sand dunes here on Earth.

The study, titled “Dunes on Pluto“, was recently published in the journal *Science*. The study was led by Matthew Telfer, a Lecturer in Physical Geography from the University of Plymouth, with significant contributions provided by Eric J. R. Parteli and Jani Radebaugh – geoscientists from the University of Cologne, and Brigham Young University, respectively.

The fine smudges on Sputnik Planum have been identified as transverse dunes because of the way they run perpendicular to the dark “wind streaks”. Credit: NASA/JPL/New Horizons

They were joined by members from the Carl Sagan Center at the SETI Institute, NASA’s Ames Research Center, the Lowell Observatory, the Southwest Research Institute (SwRI), the National Optical Astronomy Observatory, the Massachusetts Institute of Technology (MIT), the Johns Hopkins University Applied Physics Laboratory (JHUAPL), and multiple universities.

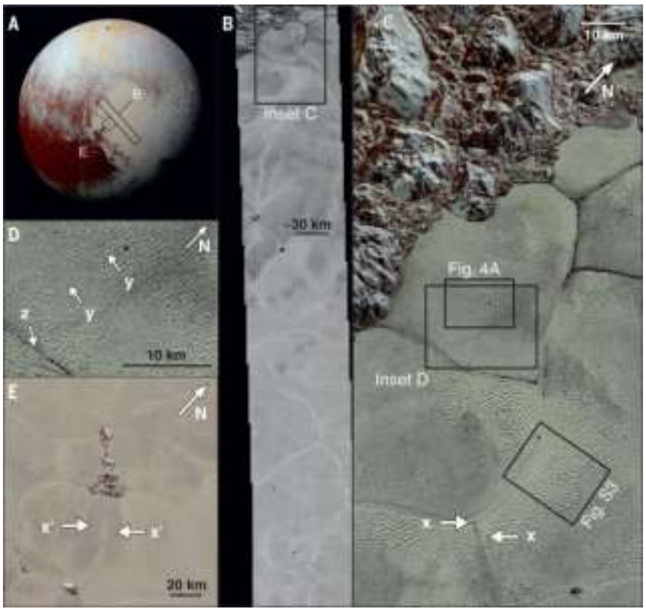
On Earth, dunes are formed by wind-blown sand that create repeated ridges in the desert or along beaches. Similar patterns have been observed along river beds and alluvial plains, where water deposits sediment over time. In all cases, dune-like formations are the result of solid particles being transported by a moving medium (i.e. air or water). Beyond Earth, such patterns have been observed on Mars, Titan, and even on Comet 67P/Churyumov-Gerasimenko.

However, when consulting images from *New Horizons* probe, Telfer and his colleagues noted similar formations in the Sputnik Planitia region on Pluto. This region, which constitutes the western lobe of the heart-shaped Tombaugh Regio, is essentially a massive ice-covered basin. Already, researchers have noted that the surface appears to consist of irregular polygons bordered by troughs, which appear to be indications of convection cells.

As Dr. Telfer told Universe Today via email:

“We first saw some features looked kind of dune-like within the first few days, but as time passed, and new images came in, most of these seemed less and less convincing. But one area became more and more convincing with every pass. This is what we’re reporting on.”

Another interesting feature is the dark streams that are a few kilometers long and are all aligned in the same direction. But equally interesting were the features that Telfer and his team noticed, which looked like dunes that ran perpendicular to the wind streaks. This indicated that they were transverse dunes, the kinds that pile up due to prolonged wind activity in the desert.



New Horizon images showing the patterns on Pluto’s surface that were hypothesized to be dunes. Credit: NASA/JPL/University of Arizona

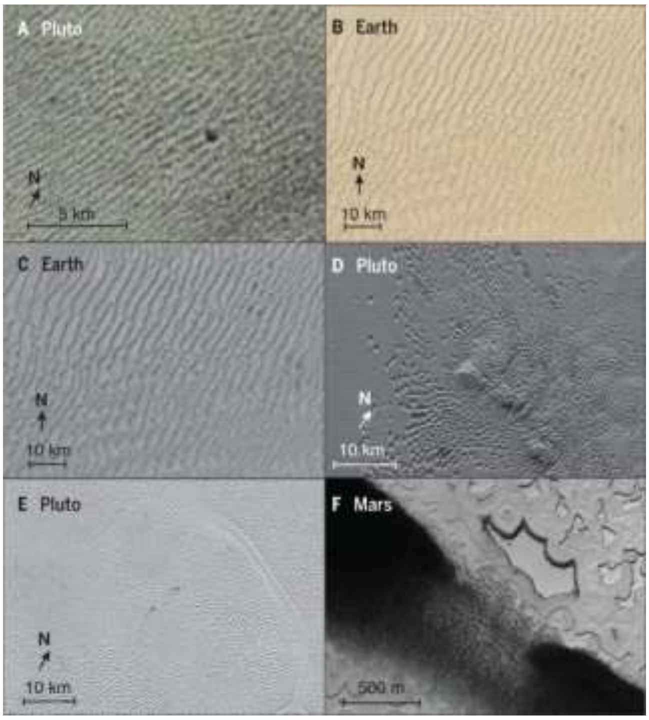
To determine if this was a plausible hypothesis, the researchers constructed models that took into account what kind of particles would make up these dunes. They concluded that either methane or nitrogen ice would be able to form sand-sized grains that could be transported by typical winds. They then modeled the physics of Pluto’s winds, which would be strongest coming down the slopes of the mountains that border Sputnik Planum.

However, they also determined that Pluto’s winds would not be strong enough to push the particles around on their own. This is where sublimation played a key role, where surface ice goes from a solid phase directly to a gas when warmed by sunlight. This sublimation would provide the upward force necessary to lift the particles, at which point they would be caught by Pluto’s winds and blown around.

As Dr. Telfer explained, this conclusion was made possible thanks to the immense amount of support his team got, much of which came from the New Horizons Geology, Geophysics and Imaging Science Theme Team:

“Once we’d done the spatial analysis that made us really sure that these features made sense as dunes, we had the great opportunity to hook up with Eric Parteli at Cologne; he showed us through his modelling that the dunes should

form, as long as the grains become airborne in the first place. The NASA New Horizons team really helped here, as they pointed out that mixed nitrogen/methane ices would preferentially fling methane ice grains upwards as the ices sublimated."



Comparison of dune features on Pluto with those on Earth and Mars. Credit: NASA/JPL/University of Arizona

In addition to showing that Pluto, one of the most distant objects in the Solar System, has a few things in common with Earth, this study has also shown just how active Pluto's surface is. "It shows us that not only is Pluto's surface affecting its atmosphere, the converse is also true," said Dr. Telfer. "We have a really dynamic world's surface, so far out in the solar system.

On top of that, understanding how dunes can form under Pluto's conditions will help scientists to interpret similar features found elsewhere in the Solar System. For example, NASA is planning on sending a mission to Titan in the coming decade to study its many interesting surface features, which include its dune formations. And many more missions are being sent to explore the Red Planet before a crewed mission takes place in the 2030s.

Knowing how such formations were created are key to understanding the dynamics of the planet, which will help answer some of the deeper questions about what is taking place on the surface.

Further Reading: ArsTechnica, Science

ENGINEERS PROPOSE A ROCKET THAT CONSUMES ITSELF AS IT FLIES TO SPACE

Article written: 2 Jun , 2018

by Matt Williams

When it comes to the new era of space exploration, one of the primary focuses has been on cutting costs. By reducing the costs associated with individual launches, space agencies and private aerospace companies will not only be able to commercialize Low Earth-Orbit (LEO), but also mount far more in the way of exploration missions and maybe even colonize space.

Several methods have been proposed so far for reducing launch costs, which include reusable rockets and single-stage-to-orbit rockets. However, a team of engineers from the University of Glasgow and the Ukraine recently proposed an entirely different idea that could make launching small payloads affordable – a self-eating rocket! This "autophage" rocket could easily send small satellites into space more easily and more affordably.

The study which describes how they built and tested the "autophage" engine recently appeared in the *Journal of Spacecraft and Rockets* under the title "Autophage Engines: Toward a Throttleable Solid Motor". The team was led by Vitaly Yemets and Patrick Harkness – a Professor from the Oles Honchar Dnipro National University in the Ukraine and a Senior Lecturer from the University of Glasgow, respectively.

The autophage engine, being tested at the Dnipro testing lab in the Ukraine. Credit: University of Glasgow

Together, the team addressed one the most pressing issues when it comes to rockets today. This has to do with the fact that storage tanks, which contain the rocket's propellants as they climb, weight many times the spacecraft's payload. This reduces the efficiency of the launch vehicle and also adds to the problem of space debris, since these fuel tanks are disposable and fall away when spent.

As Dr Patrick Harkness, who led Glasgow's contribution to the work, explained in a recent University of Glasgow press release:

"Over the last decade, Glasgow has become a centre of excellence for the UK space industry, particularly in small satellites known as 'CubeSats', which provide researchers with affordable access to space-based experiments. There's also potential for the UK's planned spaceport to be based in Scotland. However, launch vehicles tend to be large because you need a large amount of propellant to reach space. If you try to scale down, the volume of propellant falls more quickly than the mass of the structure, so there is a limit to how small you can go. You will be left with a vehicle that is smaller but, proportionately, too heavy to reach an orbital speed."

In contrast, an autophage engine consumes its own structure during ascent, so more cargo capacity could be freed-up and less debris would enter orbit. The propellant consists of a solid fuel rod (made of a solid plastic like polyethylene) on the outside and an oxidizer on the inside. By driving the rod into a hot engine, the fuel and oxidizer are vaporized to create gas that then flows into the combustion chamber to produce thrust.

The use of autophage engines on rockets could allow for the deployment of small satellites cheaply and efficiently, without adding to the problem of space debris. Credit: AMNH.

"A rocket powered by an autophage engine would be different," said Dr. Harkness. "The propellant rod itself would make up the body of the rocket, and as the vehicle climbed the engine would work its way up, consuming the body from base to tip. That would mean that the rocket structure would actually be consumed as fuel, so we wouldn't face the same problems of excessive structural mass. We could size the launch vehicles to match our small satellites, and offer more rapid and more targeted access to space."

The research team also showed that the engine could be throttled by simply varying the speed at which the rod is driven into the engine, which is something rare in a solid motor. During the lab tests, the team has been able to sustain rocket operations for 60 seconds at a time. As Dr. Harkness said, the team hopes to build on this and eventually conduct a launch test:

"While we're still at an early stage of development, we have an effective engine testbed in the laboratory in Dnipro, and we are working with our colleagues there to improve it still further. The next step is to secure further funding to investigate how the engine could be incorporated into a launch vehicle."

Another challenge of the modern space age is how to deliver additional payloads and satellites into orbit without creating more in the way of orbital clutter. By introducing an engine that can make for cheap launches that also has no disposable parts, the autophage could be a game-changing technology, one which is right up there with fully-recoverable rockets.

The research team also consisted of Mykola Dron and Anatoly Pashkov – a Professor and Senior Researcher from Oles Honchar Dnipro National University – and Kevin Worrall and Michael Middleton – a Research Associate and M.S. student from the University of Glasgow.

Further Reading: *University of Glasgow*, *Journal of Spacecraft and Rockets*

PLANETS ON PARADE: SATURN AT OPPOSITION 2018

 Article written: 31 May , 2018

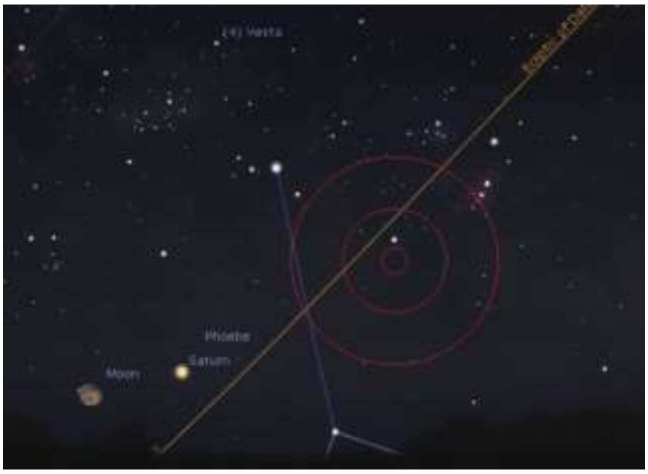
by David Dickinson

Saturn, Mars and Jupiter all beckon this summer. Image credit and copyright: Sharin Ahmad (@shahgazer).

We're in the midst of a parade of planets crossing the evening sky. Jupiter reached opposition on May 9th, and sits high to the east at dusk. Mars heads towards a fine opposition on July 27th, nearly as favorable as the historic opposition of 2003. And Venus rules the dusk sky in the west after the setting Sun for most of 2018.

June is Saturn's turn, as the planet reaches opposition this year on June 27th, rising opposite to the setting Sun at dusk.

In classical times, right up until just over two short centuries ago, Saturn represented the very outer limit of the solar system, the border lands where the realm of the planets came to an end. Sir William Herschel extended this view, when he spied Uranus—the first planet discovered in the telescopic era—slowly moving through the constellation Gemini just across the border of Taurus the Bull using a 7-foot reflector (in the olden days, telescopes specs were often quoted referring to their focal length versus aperture) while observing from his backyard garden in Bath, England on the night of March 13th, 1781.



Looking east tonight at sunset… note Vesta to the upper left. Credit: Stellarium.

Orbiting the Sun once every 29.5 years, Saturn is the slowest moving of the naked eye planets, fitting for a planet named after Father Time. Saturn slowly loops from one astronomical constellation along the zodiac to the next eastward, moving through one about every two years.

The path of Saturn through 2018. Image credit: Starry Night Education software.

2018 sees Saturn in the constellation Sagittarius the Archer, just above the 'lid' of the Teapot asterism, favoring the southern hemisphere for this apparition. Saturn won't cross the celestial equator northward again until 2026. Not that that should discourage northern hemisphere viewers from going after this most glorious of planets. A low southerly declination also means that Saturn is also up in the evening in the summertime up north, a conducive time for observing. Taking 29-30 years to complete one lap around the ecliptic as seen from our Earthly vantage point, Saturn also makes a great timekeeper with respect to personal life milestones… where were you back in 1989, when Saturn occupied the same spot along the ecliptic?

Saturn also shows the least variation of all the planets in terms of brightness and size, owing to its immense distance 9.5 AU from the Sun, and consequently 8.5 to 10.5 AU from the Earth. Saturn actually just passed its most distant aphelion since 1959 on April 17th, 2018 at 10.066 AU from the Sun.

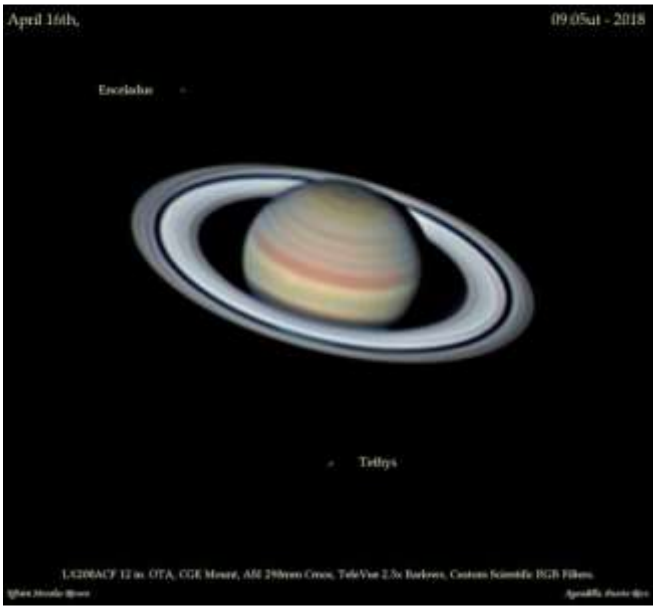
Saturn's in 2018 Dates with Destiny

Saturn sits just 1.6 degrees south of the waning gibbous Moon tonight. The Moon will lap it again one lunation later on June 28th. Note that the brightest of the asteroids, +5.7 magnitude 4 Vesta is nearby in northern Sagittarius, also reaching opposition on June 19th. Can you spy Vesta with the naked eye from a dark sky site? 4 Vesta passes just 4 degrees from Saturn on September 23rd, and both flirt with the galactic plane and some famous deep sky targets, including the Trifid and Lagoon Nebulae.

Saturn reaches quadrature 90 degrees east of the Sun on September 25th, then ends its evening apparition when it reaches solar conjunction on New Year's Day, 2019.

Saturn is well clear of the Moon's path for most of this year, but stick around: starting on December 9th, 2018, the slow-moving planet will make a great target for the Moon, which will begin occulting it for every lunation through the end of 2019.

It's ironic: Saturn mostly hides its beauty to unaided eye. Presenting a slight saffron color in appearance, it never strays much from magnitude -0.2 to +1.4 in brightness. One naked eye observation to watch for is a sudden spurt in brightness known as the opposition surge or Seeliger Effect. This is a retro reflector type effect, caused by all those tiny iceball moonlets in the rings reaching 100% illumination at once. Think of how the Full Moon is actually 3 to 4 times brighter than the 50% illuminated Quarter Moon… all those little peaks, ridges and crater rims no longer casting shadows do indeed add up.



Saturn in all its glory (note the moons Enceladus and Tethys, too!). Image credit and copyright: Efrain Morales.

And this effect is more prominent in recent years for another reason: Saturn's rings passed maximum tilt (26.7 degrees) with respect to our line of sight just last year, and are still relatively wide open in 2018. They'll start slimming down again over the next few oppositions, reaching edge-on again in 2028.

Even using a pair of 7×50 hunting binoculars on Saturn, you can tell that something is amiss. You're getting the same view that Galileo had through his spyglass, the pinnacle of early 17th century technology. He could tell that something about the planet was awry, and drew sketches showing an oblong world with coffee cup handles on the side. Crank up the magnification using even a small 60 mm refractor, and the rings easily jump into view. This is what makes Saturn a star party staple, an eye candy feast capable of drawing the aim of all the telescopes down the row.

If seeing and atmospheric conditions allow, crank up the magnification up to 150x or higher, and the dark groove of the Cassini division snaps into view. Can you see the shadow of the disk of Saturn, cast back onto the plane of the rings? The shadow of the planet hides behind it near opposition, then becomes most prominent towards quadrature, when we get to peek around its edge. Can you spy the limb of the planet itself, through the Cassini Gap?

Though the disk of Saturn is often featureless, tiny swirls of white storms do occasionally pop up. Astrophotographer Damian Peach noted just one such short-lived storm on the ringed planet this past April 2018.

Saturn's retinue of moons are also interesting to follow in there own right. The first one you'll note is +8.5 magnitude smog-shrouded Titan. Larger in diameter than Mercury, Titan would easily be a planet in its own right, were it liberated from its primary's domain.

Though Saturn has 62 known moons, only six in addition to Titan are in range of a modest backyard telescope: Enceladus, Rhea, Dione, Mimas, Tethys and Iapetus. Two-faced Iapetus is especially interesting to follow, as it varies two full magnitudes in brightness during its 79 day orbit. Arthur C. Clarke originally placed the final monolith in *2001: A Space Odyssey* on this moon, its artificial coating a beacon to astronomers. Today, we know from flybys carried out by NASA's Cassini spacecraft that the leading hemisphere of Iapetus is coated with dark in-falling material, originating from the dark Phoebe ring around Saturn.

Two-faced Iapetus as imaged by Cassini. Image credit: NASA/JPL/Space Science Institute.

Owners of large light bucket telescopes may also want to try from two fainter +15th magnitude moons: Hyperion and Phoebe.

Fun fact: Saturn's moons can also cast shadows back on the planet itself, much like the Galilean moons do on Jupiter… the catch, however, is that these events only occur around equinox season in the years around when Saturn's rings are edge-on. This next occurs starting in 2026.

Cassini finished up its thrilling 20 year mission just last year, with a dramatic plunge into Saturn itself. It will be a while before we return again, perhaps in the next decade if NASA selects a nuclear-powered helicopter to explore Titan. Until then, be sure to explore Saturn this summer, from your Earthbound backyard.

Love to observe the planets? Check out our new forthcoming book, The Universe Today Ultimate Guide to Viewing the Cosmos – out on October 23rd, now up for pre-order.

VIRGIN GALACTIC PERFORMS THE SECOND TEST OF VSS UNITY, REACHING MACH 1.9

Article written: 30 May , 2018
Updated: 30 May , 2018

by Matt Williams

When it comes to the dream of commercial space exploration and space tourism, a few names really stand out. In addition to Elon Musk and Jeff Bezos, you have Richard Branson – the founder and CEO of the Virgin Group. For years, Branson has sought to make space tourism a reality through Virgin Galactic, which would take passengers into suborbit using his SpaceShipTwo class of rocket planes.

Unfortunately, Virgin Galactic suffered a number of setbacks in recent years, at the same time that competitors like SpaceX and Blue Origin emerged as competitors. However, the VSS Unity (part of the Virgin Galactic fleet) recently conducted its second powered test flight from the Mojave Air and Space Port on Tuesday, May 29th. While this test is years behind schedule, it marks a significant step towards Branson's realization of flying customers to space.

This was the second time that the VSS Unity flew since 2014, when the VSS Enterprise suffered a terrible crash while attempting to land, killing one pilot and injuring the other. The first propulsive test took place two months ago after several additional tests were performed on the craft. And with that last success, Virgin Galactic moved ahead with its second powered test earlier this week.

The focus of the latest test flight was to learn more about how the spaceship handles at supersonic speeds. It was also intended to test the control system's performance when the vehicle was closer to its ultimate commercial configuration. As the company stated, "This involved shifting the vehicle's center of gravity rearward via the addition of passenger seats and related equipment."

This statement is a possible indication that the test program is reaching the final stretch before Virgin Galactic allows passengers on the vehicle. However, the company will need to conduct a full-duration flight (which will include a full-duration burn of its rocket motor) before that can happen. This latest test involved only a partial rocket burn, but nevertheless demonstrated the spacecraft's capabilities at supersonic speed.

The company live-tweeted the entire event, which began at 8:34 AM with the VSS Unity and its carrier mothership (VMS Eve) taxing out to the runway for final checks. For this flight, the pilots were Dave Mackay and Mark "Forger" Stucky while CJ Sturckow and Nicola Pecile piloted of the carrier aircraft. At 8:42 AM (PDT), both craft lifted off, with the company tweeting, "We have take-off. VMS Eve & VSS Unity have taken to the skies and have begun their climb."

By 9:43 AM, the company announced that the VSS Unity had detached from the VMS Eve and was "flying free". What followed was a series of live-tweets that indicated the ignition of the VSS Unity's rocket motor, the shutting down of the motor, and the raising of the tail fins to the "feathered" re-entry position. By 9:55 AM, the company announced a smooth landing for the VSS Unity, signaling the end of the test.

Branson, who was at the Mojave Air and Space Port for the test, released the following statement shortly thereafter:

"It was great to see our beautiful spaceship back in the air and to share the moment with the talented team who are taking us, step by step, to space. Seeing Unity soar upwards at supersonic speeds is inspiring and absolutely breathtaking. We are getting ever closer to realizing our goals. Congratulations to the whole team!"

Branson was also at the center to take in a tour of the facilities of The Spaceship Company (TSC), a sister company of Virgin Galactic that is responsible for developing Virgin Galactic's future fleet. While there, Branson viewed the next two spaceships that TSC is currently manufacturing, as well as the production facilities for TSC's spaceship rocket motors.

With the latest test flight complete, the company's teams will be reviewing the data from this flight and making preparations for the next flight. No indication has been given as to when that will be, or if this test flight will include a full-duration burn of the motor. However, Branson was very happy with the test results, stating:

"Today we saw VSS Unity in her natural environment, flying fast under rocket power and with a nose pointing firmly towards the black sky of space. The pathway that Unity is forging is one that many thousands of us will take over time, and will help share a perspective that is crucial to solving some of humanity's toughest challenges on planet Earth."

Artists' impression of Moon Base Alpha, SpaceX's envisioned lunar outpost supplied with the BFR. Credit: SpaceX

Meanwhile, Bezos continues to pursue his plans for sending passengers into orbit using his fleet of New Shepard rockets. And of course, Musk continues to pursue the idea of sending tourists to the Moon and Mars using his Big Falcon Rocket (BFR). And with many other private aerospace ventures looking to provide trips into orbit or to the surface of the Moon, there is sure to be no shortage of options for going into space in the near future!

Two Spacecraft Will Get Closer to the Sun Than Ever Before

Article written: 25 May , 2018
Updated: 25 May , 2018

by Matt Williams

Our understanding of distant stars has increased dramatically in recent decades. Thanks to improved instruments, scientists are able to see farther and clearer, thus learning more about star systems and the planets that orbit them (aka. extra-solar planets). Unfortunately, it will be some time before we develop the necessary technology to explore these stars up close.

But in the meantime, NASA and the ESA are developing missions that will allow us to explore our own Sun like never before. These missions, NASA's Parker Solar Probe and the ESA's (the European Space Agency) Solar Orbiter, will explore closer to the Sun than any previous mission. In so doing, it is hoped that they will resolve decades-old questions about the inner workings of the Sun.

These missions – which will launch in 2018 and 2020, respectively – will also have significant implications for life here on Earth. Not only is sunlight essential to life as we know it, solar flares can pose a major hazard for technology that humanity is becoming increasingly dependent on. This includes radio communications, satellites, power grids and human spaceflight.

And in the coming decades, Low-Earth Orbit (LEO) is expected to become increasingly crowded as commercial space stations and even space tourism become a reality. By improving our understanding of the processes that drive solar flares, we will therefore be able to better predict when they will occur and how they will impact Earth, spacecraft, and infrastructure in LEO.

As Chris St. Cyr, the Solar Orbiter project scientist at NASA's Goddard Space Flight Center, explained in a recent NASA press release:

"Our goal is to understand how the Sun works and how it affects the space environment to the point of predictability. This is really a curiosity-driven science."

Both missions will focus on the Sun's dynamic outer atmosphere, otherwise known as the corona. At present, much of the behavior of this layer of the Sun is unpredictable and not well understood. For instance, there's the so-called "coronal heating problem", where the corona of the Sun is so much hotter than the solar surface. Then there is the question of what drives the constant outpouring of solar material (aka. solar wind) to such high speeds.

As Eric Christian, a research scientist on the Parker Solar Probe mission at NASA Goddard, explained:

"Parker Solar Probe and Solar Orbiter employ different sorts of technology, but — as missions — they'll be complementary. They'll be taking pictures of the Sun's corona at the same time, and they'll be seeing some of the same structures — what's happening at the poles of the Sun and what those same structures look like at the equator."

Illustration of the Parker Solar Probe spacecraft approaching the Sun. Credits: Johns Hopkins University Applied Physics Laboratory

For its mission, the Parker Solar Probe will get closer to the Sun than any spacecraft in history – as close as 6 million km (3.8 million mi) from the surface. This will replace the previous record of 43.432 million km (~27 million mi), which was established by the Helios B probe in 1976. From this position, the Parker Solar Probe will use its four suites of scientific instruments to image the solar wind and study the Sun's magnetic fields, plasma and energetic particles.

In so doing, the probe will help clarify the true anatomy of the Sun's outer atmosphere, which will help us to understand why the corona is hotter than the Sun's surface. Basically, while temperatures in the corona can reach as high as a few million degrees, the solar surface (aka. photosphere), experiences temperatures of around 5538 °C (10,000 °F).

Meanwhile, the Solar Orbiter will come to a distance of about 42 million km (26 million mi) from the Sun, and will assume a highly-tilted orbit that can provide the first-ever direct images of the Sun's poles. This is another area of the Sun that scientists don't yet understand very well, and the study of it could provide valuable clues as to what drives the Sun's constant activity and eruptions.

Both missions will also study solar wind, which is the Sun's most pervasive influence on the solar system. This steam of magnetized gas fills the inner Solar System, interacting with magnetic fields, atmospheres and even the surfaces of planets. Here on Earth, it is what is responsible for the Aurora Borealis and Australis, and can also play havoc with satellites and electrical systems at times.

Artist's impression of a solar flare erupting from the Sun's surface. Credit: NASA Goddard Space Flight Center

Previous missions have led scientists to believe that the corona contributes to the process that accelerates solar wind to such high speeds. As these charged particles leave the Sun and pass through the corona, their speed effectively triples. By the time the solar wind reaches the spacecraft responsible for measuring it – 148 million km (92 million mi) from the Sun – it has plenty of time to mix with other particles from space and lose some of its defining features.

By being parked so close to the Sun, the Parker Solar Probe will able to measure the solar wind just as it forms and leaves the corona, thus providing the most accurate measurements of solar wind ever recorded. From its perspective above the Sun's poles, the Solar Orbiter will complement the Parker Solar Probe's study of the solar wind by seeing how the structure and behavior of solar wind varies at different latitudes.

This unique orbit will also allow the Solar Orbiter to study the Sun's magnetic fields, since some of the Sun's most interesting magnetic activity is concentrated at the poles. This magnetic field is far-reaching largely because of solar wind, which reaches outwards to create a magnetic bubble known as the heliosphere. Within the heliosphere, solar wind has a profound effect on planetary atmospheres and its presence protects the inner planets from galactic radiation.

In spite of this, it is still not entirely clear how the Sun's magnetic field is generated or structured deep inside the Sun. But given its position, the Solar Orbiter will be able to study phenomena that could lead to a better understanding of how the Sun's magnetic field is generated. These include solar flares and coronal mass ejections, which are due to variability caused by the magnetic fields around the poles.

In this way, the Parker Solar Probe and Solar Orbiter are complimentary missions, studying the Sun from different vantage points to help refine our knowledge of the Sun and heliosphere. In the process, they will provide valuable data that could help scientists to tackle long-standing questions about our Sun. This could help expand our knowledge of other star systems and perhaps even answer questions about the origins of life.

As Adam Szabo, a mission scientist for Parker Solar Probe at NASA Goddard, explained:

"There are questions that have been bugging us for a long time. We are trying to decipher what happens near the Sun, and the obvious solution is to just go there. We cannot wait — not just me, but the whole community."

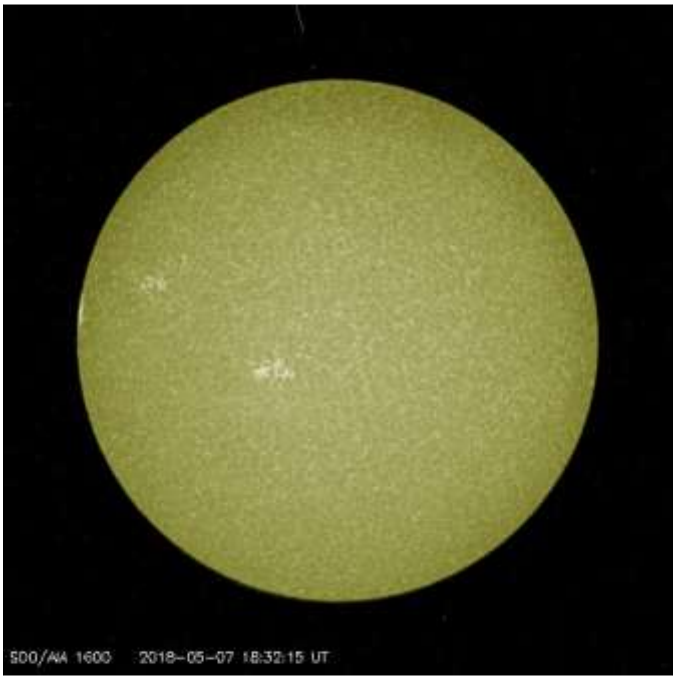
In time, and with the development of the necessary advanced materials, we might even be able to send probes into the Sun. But until that time, these missions represent the most ambitious and daring efforts to study the Sun to date. As with many other bold initiatives to study our Solar System, their arrival cannot come soon enough!

Further Reading: NASA

ARE WE HEADED TOWARDS ANOTHER DEEP SOLAR MINIMUM?

Article written: 22 May , 2018

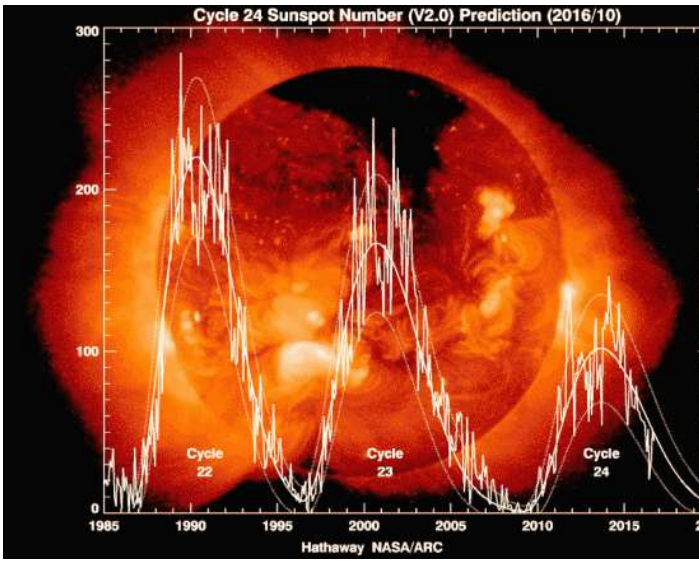
by David Dickinson



A (nearly) naked Sol… more the norm than the exception these days. Credit: NASA/SDO AIA 512/1600 imager.

Have you been keeping an eye on Sol lately? One of the top astronomy stories for 2018 may be what's *not* happening, and how inactive our host star has become.

The strange tale of Solar Cycle #24 is ending with an expected whimper: as of May 8th, the Earthward face of the Sun had been spotless for 73 out of 128 days thus far for 2018, or more than 57% of the time. This wasn't entirely unexpected, as the solar minimum between solar cycle #23 and #24 saw 260 spotless days in 2009 – the most recorded in a single year since 1913. Cycle #24 got off to a late and sputtering start, and though it produced some whopper sunspots reminiscent of the Sol we knew and loved on 20th century cycles past, it was a chronic under-performer overall. Mid-2018 may see the end of cycle #24 and the start of Cycle #25… or will it?



The story thus far… and the curious drama that is solar cycle #24. Credit: David Hathaway/NASA Marshall Spaceflight Center.

One nice surprise during Cycle #24 was the appearance of massive sunspot AR 2192, which popped up just in time for the partial solar eclipse of October 23rd, 2014. Several times the size of the Earth, the spot complex was actually the largest seen in a quarter century. But just as "one swallow does not a Summer make," one large sunspot group couldn't save Solar Cycle #24.

The partial eclipse of the Sun, October 23, 2014, as seen from Jasper, Alberta, shot under clear skies through a mylar filter, on the front of a 66mm f/6 apo refractor using the Canon 60Da for 1/8000 (!) sec exposure at ISO 100. The colors are natural, with the mylar filter providing a neutral "white light" image. The big sunspot on the Sun that day is just beginning to disappear behind the Moon's limb. The mylar filter gave a white Sun, its natural colour, but I have tinted the Sun's disk yellow for a more pleasing view that is not just white Sun/black sky. Image credit and copyright: Alan Dyer/Amazing Sky.net

The Sun goes through an 11-year sunspot cycle, marked by the appearance of new spots at mid- solar latitudes, which then slowly progress to make subsequent appearances closer towards the solar equator, in a pattern governed by what's known as Spörer's Law. The hallmark of a new solar cycle is the appearance of those high latitude spots. The Sun actually flips overall polarity every cycle, so a proper Hale Cycle for the Sun is actually 11 x 2 = 22 years long.

A big gaseous fusion bomb, the Sun actually rotates once every 25 days near its equator, and 34 days at the poles. The Sun's rotational axis is also tipped 7.25 degrees relative to the ecliptic, with the northern rotational pole tipped towards us in early September, while the southern pole nods towards us in early March.

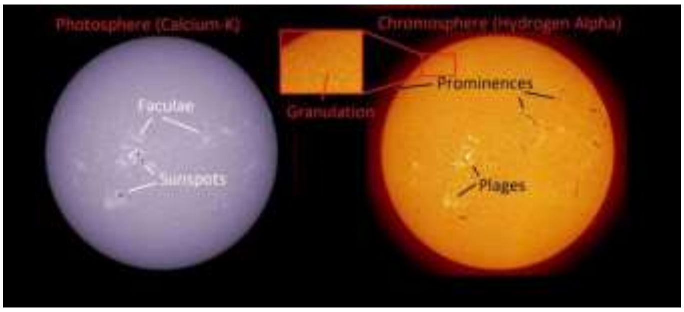
An animation of massive susnpot AR 2192 crossing the Earthward face of Sol from October 17th to October 29th, 2014. Credit: NASA/SDO.

What's is store for Cycle #25? One thing's for certain: if the current trend continues, with spotless days more the rule than the exception, we could be in for a deep profound solar minimum through the 2018 to 2020 season, the likes of which would be unprecedented in modern astronomy.

Fun fact: a similar dearth of sunspots was documented during the 1645-1715 period referred to as the Maunder Minimum. During this time, crops failed and the Thames River in London froze, making "frost fairs" along its frozen shores possible. Ironically, the Maunder Minimum also began just a few decades after the dawn of the age of telescopic astronomy. During this time, the idea of "spots on the Sun" was regulated to a controversial, and almost mythical status in mainstream astronomy.

Keeping Vigil on a Tempestuous (?) Star

We've managed to study the last two solar cycles with unprecedented scrutiny. NASA's STEREO-A and -B spacecraft (Only A is currently active) monitors the farside of the Sun from different vantage points. The Solar Dynamics Observatory (NASA SDO) keeps watch on the Sun across the electromagnetic spectrum. And our favorite mission, the joint NASA/European Space Agency's SOHO spacecraft, has monitored the Sun from its sunward L1 Lagrange vantage point since it launched in 1995—nearly through one complete 22 year Hale Cycle by mid- 2020s. Not only has SOHO kept a near-continuous eye on Sol, but it's also discovered an amazing 3,398 sungrazing comets as of September 1st, 2017… mostly due to the efforts of diligent online amateur astronomers.



A guide to features on the Sun. The left view in Calcium-K shows the photosphere and is similar to a standard whitelight view, and the right view shows features in the chromosphere in hydrogen-alpha. Credit: Paul Stewart Instagram: @Upsidedownastronomer/annotations by Dave Dickinson

…and did you know: we can actually model the solar farside currently *out of view* from the Earth to a high degree of fidelity thanks to the advent of powerful computational methods used in the nascent field of solar helioseismology.

Unfortunately, this low ebb in the solar cycle will also make for lackluster aurora in the years to come. It's a shame, really… the relatively powerful cycles of the 1970s and 80s hosted some magnificent aurorae seen from mid-latitudes (and more than a few resulting blackouts). We're still getting some minor outbursts, but you'll have to venture "North/South of the 60" to *really* see the aurorae in all of its splendor over the next few years.

But don't take our word for it: get out there and observe the Sun for yourself. Don't let this discourage you when it comes to observing the Sun. Even near its minimum, the Sun is a fascinating target of study… and unlike most astronomical objects, the face of the Sun can change very quickly, sometimes erupting with activity from one hour to the next.

We like to use a Coronado Personal Solar Telescope to monitor the Sun in hydrogen-alpha for prominences and filaments: such a scope can be kept at the ready to pop outside at lunch time daily for a quick look. For observing sunspots and the solar photosphere in white-light, you'll need an approved glass filter which fits snugly over the aperture end of your telescope or camera, or you can make a safe solar filter with Baader Safety Film.

Safe ways to observe the Sun: a homemade whitelight filter (left) and a Coronado PST solar telescope (right). Images by author.

Does the sunspot cycle tell the whole picture? Certainly, the Sun most likely has longer, as yet undiscovered cycles. For about a century now, astronomers have used the Wolf Sunspot Number as calculated mean average to describe the current state of activity seen on the Sun. An interesting study calls this method into question, and notes that the direction and orientation of the heliospheric current sheet surrounding the Sun seems to provide a better overall depiction of solar activity.

Other mysteries of the Sun include: just why does the solar cycle seem baked in at 11 years? Why don't we ever see spots at the poles? And what's in store for the future? We do know that solar output is increasing to the tune of 1% every 100 million years… and a billion years from now, Earth will be a toasty place, probably too warm to sustain liquid water on its surface…

Which brings us to the final point: what role does the solar cycle play versus albedo, global dimming and climate? This is a complex game to play: Folks have literally gone broke trying to link the solar cycle with terrestrial human affairs and everything from wheat crops to stock market fluctuations. Many a climate change-denier will at least concede that the current climate of the Earth is indeed changing, though they'll question human activity's role in it. The rather ominous fact is, taking only current solar activity into account, we should be in a *cooling* trend right now, a signal in the data that anthropogenic climate change is working hard against.

See for yourself. You can keep track of Sol's daily activity online: our favorite sites are SpaceWeather, NOAA's space weather/aurora activity page, and the SOHO and SDO websites.

Be sure to keep tabs of Sol, as the next solar minimum approaches and we ask the question: will Cycle #25 occur at all?

Well, we're finally emerging from our self-imposed monastic exile that is editing to mention we've got a book coming out later this year: *The Universe Today Ultimate Guide to Viewing the Cosmos: Everything You Need to Know to Become an Amateur Astronomer*, and yes, there's a whole chapter dedicated to solar observing and aurora. The book is up for pre-order now, and comes out on October 23rd, 2018!

NASA CUBESAT TAKES A PICTURE OF THE EARTH AND MOON

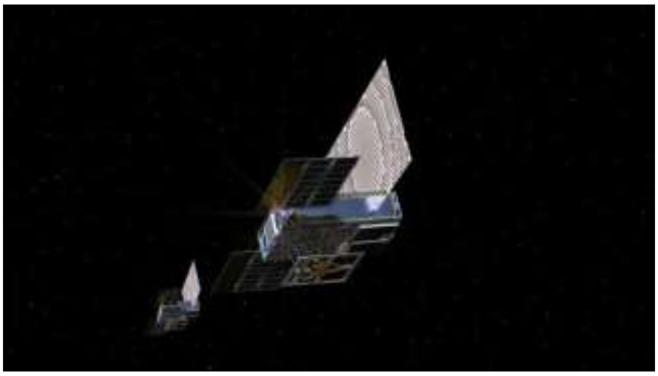
Article written: 18 May , 2018

by Matt Williams

In 1990, the *Voyager 1* spaceprobe took a picture of Earth when it was about 6.4 billion km (4 billion mi) away. In this image, known as the "pale blue dot", Earth and the Moon appeared as mere points of light because of the sheer distance involved. Nevertheless, it remains an iconic photo that not only showed our world from space, but also set long-distance record.

As it turns out, NASA set another long-distance record for CubeSats last week (on May. 8th, 2018) when a pair of small satellites called Mars Cube One (MarCO) reached a distance of 1 million km (621,371 mi) from Earth. On the following day, one of the CubeSats (MarCO-B, aka. "Wall-E") used its fisheye camera to take its own "pale blue dot" photo of the Earth-Moon system.

The two CubeSats were launched on May 5th along with the Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) lander, which is currently on its way to Mars to explore the planet's interior structure. As the first CubeSats to fly to deep pace, the purpose of the MarCO mission is to demonstrate if CubeSats are capable of acting as a relay with long-distance spacecraft.



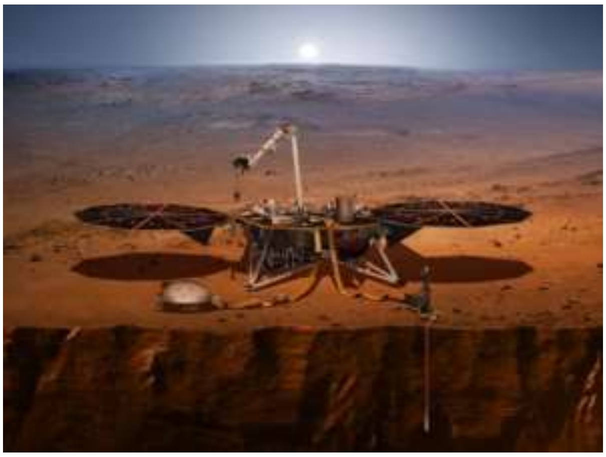
An artist's rendering of the twin Mars Cube One (MarCO) spacecraft as they fly through deep space. Credit: NASA/JPL-Caltech

To this end, the probes will be responsible for monitoring InSight as it makes its landing on Mars in late November, 2018. The photo of Earth and the Moon was taken as part of the process used by the engineering team to confirm that the spacecraft's high-gain antenna unfolded properly. As Andy Klesh, MarCO's chief engineer at NASA's Jet Propulsion Laboratory, indicated in a recent NASA press release:

"Consider it our homage to Voyager. CubeSats have never gone this far into space before, so it's a big milestone. Both our CubeSats are healthy and functioning properly. We're looking forward to seeing them travel even farther."

This technology demonstration, and the long-distance record recently set by MarCO satellites, provides a good indication of just how far CubeSats have come in the past few years. Originally, CubeSats were developed to teach university students about satellites, but have since become a major commercial technology. In addition to providing vast amounts of data, they have proven to be a cost-effective alternative to larger, multi-million dollar satellites.

The MarCO CubeSats will be there when the InSight lander accomplishes the most difficult part of its mission, which is entering Mars' extremely thin atmosphere (which makes landings extremely challenging). As the lander travels to Mars, MarCO-A and B will travel along behind it and (should they make it all the way to Mars) radio back data about InSight as it enters the atmosphere and descends to the planet's surface.



Artist's interpretation of the InSight mission on the ground on Mars. Credit: NASA

The job of acting as a data relay will fall to NASA's Mars Reconnaissance Orbiter (MRO), which has been in orbit of Mars since 2006. However, the MarCOs will also be monitoring InSight to see if future missions will be capable of bringing their own relay to Mars, rather than having to rely on an orbiter that is already there. They may also demonstrate a number of experimental technologies, which includes their radio and propulsion systems.

The main attraction though, are the high-gain antennas which will be providing information on InSights' progress. At the moment, the team has received early confirmation that the antennas have successfully deployed, but they will continue to test them in the weeks ahead. If all goes according to plan, the MarCOs could demonstrate the ability of CubeSats to act not only as relays, but also their ability to gather information on other planets.

In other words, if the MarCOs are able to make it to Mars and track InSight's progress, NASA and other agencies may contemplate mounting full-scale missions using CubeSats – sending them to the Moon, Mars, or even beyond. Later this month, the MarCOs will attempt their first trajectory correction maneuvers, which will be the first such maneuver are performed by CubeSats.

Gaia Turns Up 13,928 White Dwarfs Nearby the Sun, Including Several Formed Through Mergers

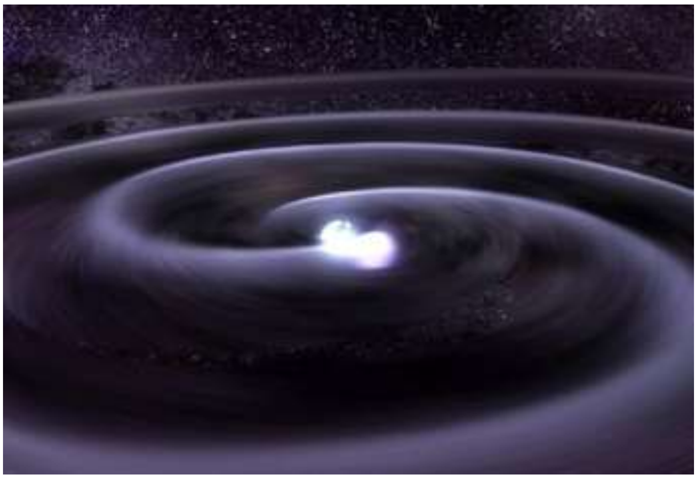
Article written: 16 May , 2018

by Matt Williams

In 2013, the European Space Agency (ESA) deployed the *Gaia* mission, a space observatory designed to measure the positions of movements of celestial bodies. For the past four years, *Gaia* has been studying distant stars, planets, comets, asteroids, quasars and other astronomical objects, and the data it has acquired will be used to construct the largest and most precise 3D space catalog ever made, totaling 1 billion objects.

The second release of *Gaia* data, which took place on April 25th, 2018, has already resulted in a number of impressive discoveries. The latest was made by an international team of scientists who identified 13,928 white dwarfs within 100 parsecs (326 light-years) of the Sun, many of which were formed through mergers. This is the first time that white dwarf stars have been directly detected within the Solar neighborhood.

The study which describes their findings, "Gaia Reveals Evidence for Merged White Dwarfs", recently appeared online and is being considered for publication in the *Monthly Notices of the Royal Astronomical Society.* The study was led by Dr. Mukremin Kilic, an associate professor at the University of Oklahoma, and included members from the Institute for Astronomy at the University of Edinburgh and the University of Montreal.



Artist impression of colliding white dwarfs. Credit: CfA

Basically, white dwarfs are what become of the majority of stars (with masses less than 8 Solar masses) once they exit the main sequence phase of their lives. This consists of a star exhausting its hydrogen fuel and expanding to several times its size (entering its Red Giant Branch Phase). These stars then blow off their external layers (a supernova) and leaving behind a white dwarf remnant.

By studying them, astronomers can learn far more about the life cycle of stars and how they evolve. As Dr. Kilic explained to Universe Today via email:

"[W]e're basically doing Galactic archaeology when we study nearby white dwarfs. They tell us about the ages and star formation histories of the Galactic disk and halo. More importantly, white dwarfs explode as a Type Ia supernova when they reach 1.4 times the mass of the Sun. We use these supernovae to study the shape of the Universe and conclude that the expansion of the universe is accelerating. However, we have not yet found the progenitor systems of these supernovae. One of the channels to form Type Ia supernovae is through mergers of white dwarfs. Hence, the direct detection of merged white dwarfs is important for understanding the frequency of these white dwarf mergers."

However, until recently only a few hundred white stars have been found within the local galactic neighborhood (500 within a 40 parsec radius). In addition, astronomers were only able to obtain accurate parallax (distance) measurements for about half of these. But thanks to the *Gaia* data, the number of white dwarfs systems that astronomers are able to study has increased exponentially.

Artist's impression of a white dwarf star in orbit around Sirius (a white supergiant). Credit: NASA, ESA and G. Bacon (STScI)

"*Gaia* provided distance measurements," said Kilic. "We can now create complete samples of white dwarfs within a given volume. For example, prior to *Gaia*, we only knew about 100 white dwarfs within 20 parsecs of the Sun. With Gaia Data Release 2, we identified more than 13,000 white dwarfs within 100 parsecs of the Sun. The difference in numbers is amazing!"

The *Gaia* data was also helpful in determining the nature of these white dwarf systems and how they formed. As they indicate in their study, previous research has shown that the majority of white dwarf stars in our local galaxy (roughly 56%) are the product of single-star evolution, whereas 7 to 23% were the product of mergers between binaries. The remainder were white dwarf binaries, or binaries with one white dwarf and a main sequence star.

Using the *Gaia* data – which included the color and distribution data of thousands of white dwarf stars within ~326 light-years of the Sun – the team was able to determine how massive these stars are. This, in turn, provided vital clues as to how they formed, which indicated that mergers were far more common than previous studies suggested. As Kilic explained:

"Massive white dwarfs tend to be smaller, which means that they are also fainter (since they have a smaller surface area). Since Gaia gave us a complete sample of white dwarfs within 100 parsecs of the Sun, for the first time, we were able to derive the magnitude distribution (hence the mass distribution) of thousands of white dwarfs and find a large fraction of massive white dwarfs. We see that the number of massive white dwarfs is significantly higher than expected from single star evolution. Therefore, we concluded that many of these massive white dwarfs actually formed through mergers in previously binary systems."

Artist's impression of white dwarf binary pair CSS 41177. Credit: Andrew Taylor.

From this, the team was able to assemble the first reliable Hertzsprung-Russell Diagram for nearby field white dwarf stars, as well as estimates on how often white dwarf binaries merge. As Kilic indicated, this could have significant implications for other areas of astronomical study.

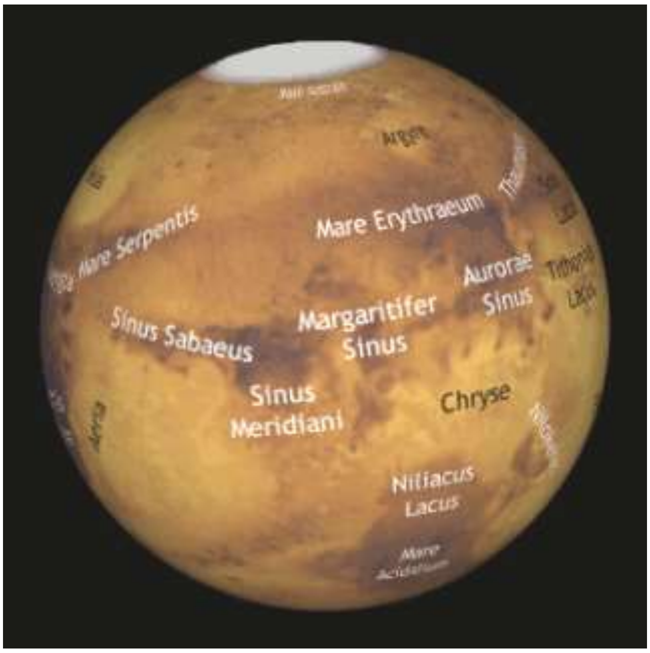
"Based on the frequency of these single white dwarfs that formed through mergers, we can estimate how many white dwarf mergers occur on average and with what mass distribution," he said. "We can then infer the rate of Type Ia supernovae from these mergers and see if it's enough to explain part or all of the Ia supernova explosions. This is an ongoing area of research and I'm sure we will some results on these very soon."

These findings are yet another gem to come from the second *Gaia* data release, which has proven to be a treasure trove for astronomers. 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).

Further Reading: arXiv

Get ready for viewing Mars this summer during its closest approach for 15 years

26 May 2018 Ade Ashford



This computer simulation depicts a full rotation of Mars at opposition on 27 July 2018. The Red Planet makes its closest approach to Earth at 0745 UT on 31 July when the centres of both planets lie 0.385 astronomical units, or 57.6 million kilometres (35.8 million miles) apart – the Red Planet's closest approach to us for 15 years. At this instant Mars displays a disc 24.3 arcseconds in diameter, shines at magnitude -2.77 and the planet's south pole is tipped towards Earth. AN animation by Ade Ashford.You may wish to circle **Friday, 27 July** on your calendar. On that morning planet Mars reaches opposition in the constellation of Capricornus, lies almost opposite the Sun and may be found highest in the southern sky around 1am local time for observers in Western Europe. Furthermore, on the evening of 27 July – in a rare bonus for observers in the UK – the planet rises in the southeast around 10pm BST, less than 6 degrees south of a **totally eclipsed Moon**.

While one may logically assume that 27 July is also the date that Mars is nearest the Earth, this is not the case. Owing to the eccentricity of the Red Planet's orbit and that of our own, the least distance between Mars and Earth doesn't occur until **8:45am BST** on **Tuesday, 31 July**. Only the opposition of 2003 saw Mars get closer – 0.373 astronomical units, or 55.8 million kilometres (34.6 million miles) on 27 August of that year.

In 2018, the distance between the centres of Earth and Mars will shrink to 0.385 astronomical units, or 35.8 million miles (57.6 million kilometres) on 31 July. The Red Planet will then reach a maximum angular size of 24.3 arcseconds when a telescope magnifying just 80x will enlarge it to the same size as the full Moon appears to the unaided eye.

When Mars is close it is an imposing naked-eye sight in the night sky. It glows with a steady orange-red hue at magnitude -2.8 in the deep twilight hours of late July, far outshining any star. Sadly for UK-based observers, however, the Red Planet will be very low in the sky, peaking at just 11 degrees above the southern horizon as seen from the heart of the British Isles. Observers in the Southern Hemisphere fare much better. For example, as seen from the New Zealand capital, Mars attains a maximum altitude of 74 degrees in the northern sky at the end of July 2018.

Making the most of Mars low in the sky seen from the UK

There is no denying that observing Mars from the British Isles in July-August 2018 will be a challenge, but there are ways that you can mitigate shimmering high-magnification planetary views. If you take the telescope outside from a warm room, always ensure that its optics have adequate time to cool down to equilibrium with the nighttime air (an hour is advised) before making critical observations. Try to avoid setting up on concrete or asphalt that retains the daytime heat; observing on grass is best. Also, try not to view Mars over the rooftops of houses where turbulent warm air currents are found.

If at all possible, do try to observe Mars within half an hour or so of the time it transits (see our **Almanac** for local times) so that it is as high as possible above your southern horizon (or northern horizon if you live south of the equator). While there is not much we can do about poor seeing arising in the atmosphere, those nights that are slightly misty when a high-pressure system sits above us often show the steadiest planetary views.

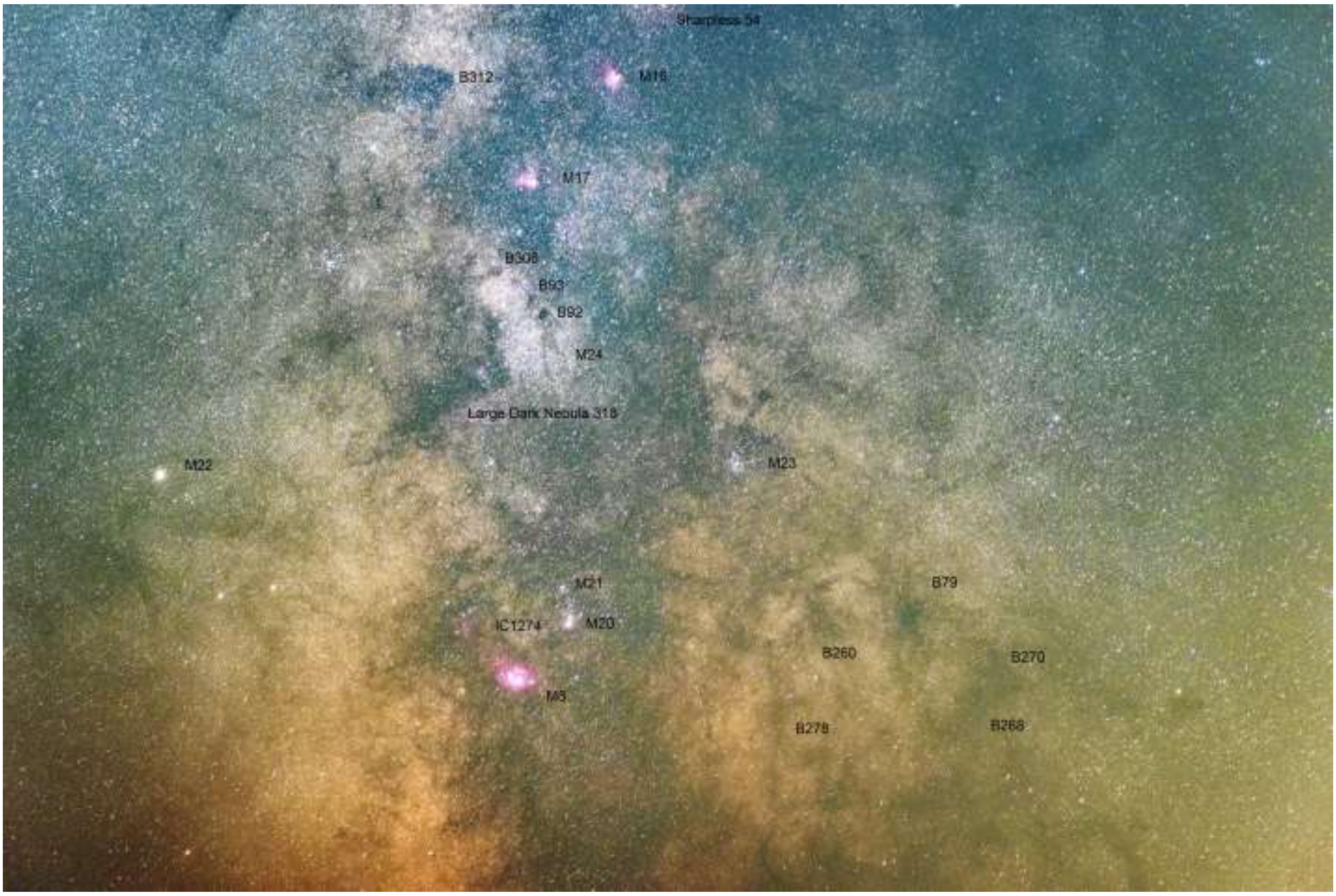
Even if the seeing is otherwise good UK-based observers will experience atmospheric dispersion, where the upper and lower limbs of the planet appear to have prismatic blue and red fringing, respectively, due to our atmosphere acting like a weak lens. You can purchase an **atmospheric dispersion filter** to help counteract this, but a simple yellow/orange filter will help.

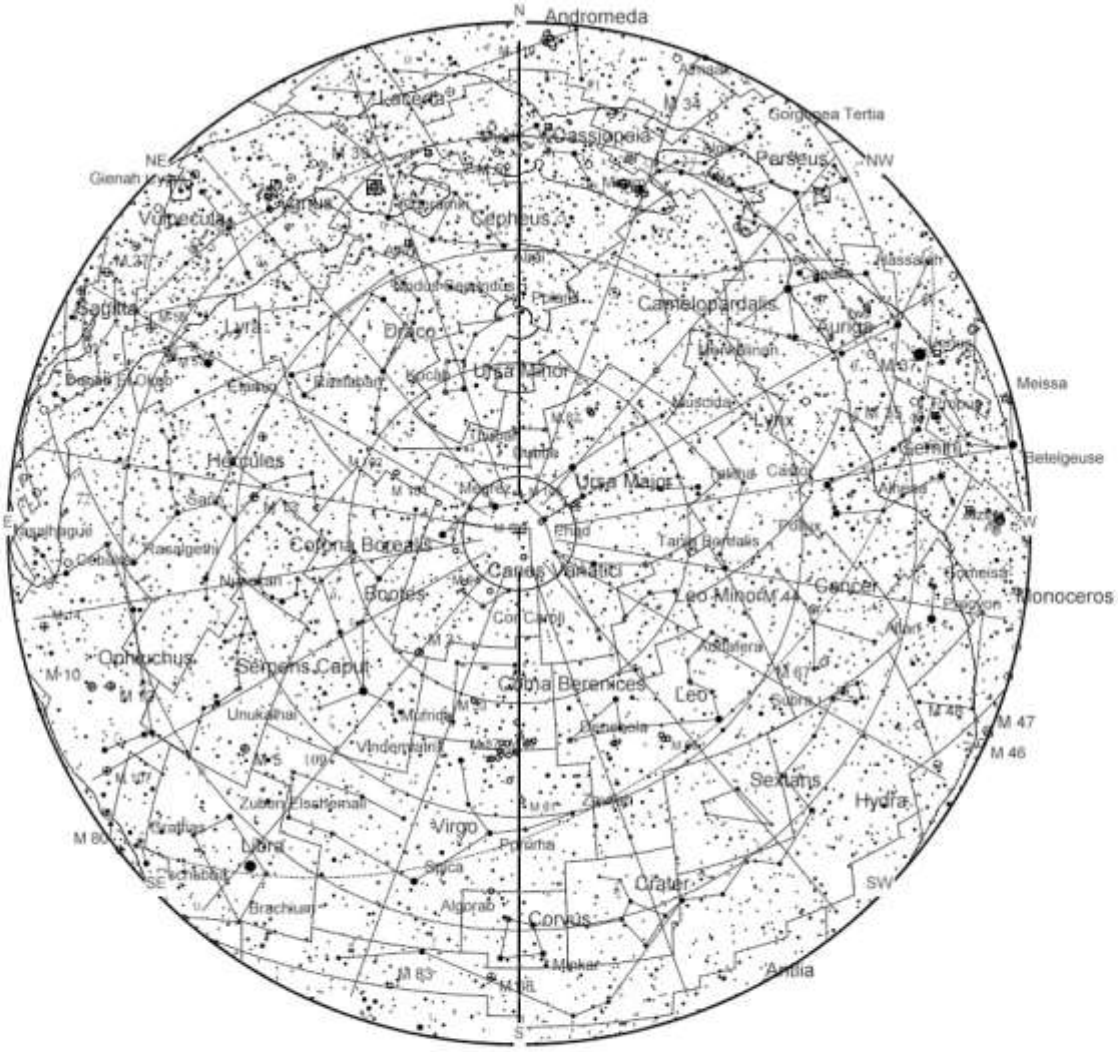
Which side of Mars is facing Earth tonight?
In quality telescopes of 6-inch (15-cm) aperture and larger, Mars reveals a wealth of surface detail when seeing conditions are good. A 3-inch (7.6-cm) 'scope is sufficient to reveal larger features such as the Syrtis Major, Hellas or the Mare Sirenum. For this opposition, Mars' southern pole is tipped about 11 degrees towards Earth in a position angle of about 6 degrees.

Note that the South Polar Cap (SPC) varies in size, being most extensive around the Martian southern spring equinox on 23 May 2018. The approximate size of the SPC at opposition is shown on our Mars Mapper app. The Red Planet also shows an appreciable phase several weeks before or after opposition. To help you identify the main surface features visible from now through to the end of October 2018, make use of our interactive **Mars Mapper** web app below, or visit its **homepage**.

Scutum and the Milky Way…

Andy Burns, Nikon D810a, 85mm lens 60seconds 2000 ISO.





June 13 - **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 19:44 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.

June 21 - **June Solstice.** The June solstice occurs at 10:07 UTC. The North Pole of the earth will be tilted toward the Sun, which will have reached its northernmost position in the sky and will be directly over the Tropic of Cancer at 23.44 degrees north latitude. This is the first day of summer (summer solstice) in the Northern Hemisphere and the first day of winter (winter solstice) in the Southern Hemisphere.

June 27 - **Saturn at Opposition.** The ringed planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Saturn and its moons. A medium-sized or larger telescope will allow you to see Saturn's rings and a few of its brightest moons.

June 28 - **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 04:53 UTC. This full moon was known by early Native American tribes as the Full Strawberry Moon because it signaled the time of year to gather ripening fruit. It also coincides with the peak of the strawberry harvesting season. This moon has also been known as the Full Rose Moon and the Full Honey Moon.

July 12 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 26.4 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

July 13 - **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 02:48 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.

July 13 - **Partial Solar Eclipse.** A partial solar eclipse occurs when the Moon covers only a part of the Sun, sometimes resembling a bite taken out of a cookie. A partial solar eclipse can only be safely observed with a special solar filter or by looking at the Sun's reflection. This partial eclipse will only be visible in extreme southern Australia and Antarctica. (**NASA Map and Eclipse Information**)

July 27 - **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 20:22 UTC. This full moon was known by early Native American tribes as the Full Buck Moon because the male buck deer would begin to grow their new antlers at this time of year. This moon has also been known as the Full Thunder Moon and the Full Hay Moon.

July 27 - **Total Lunar Eclipse.** A total lunar eclipse occurs when the Moon passes completely through the Earth's dark shadow, or umbra. During this type of eclipse, the Moon will gradually get darker and then take on a rusty or blood red color. The eclipse will be visible throughout most of Europe, Africa, western and central Asia, the Indian Ocean, and Western Australia. (**NASA Map and Eclipse Information**)

July 27 - **Mars at Opposition.** The red planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Mars. A medium-sized telescope will allow you to see some of the dark details on the planet's orange surface.

July 28, 29 - **Delta Aquarids Meteor Shower.** The Delta Aquarids is an average shower that can produce up to 20 meteors per hour at its peak. It is produced by debris left behind by comets Marsden and Kracht. The shower runs annually from July 12 to August 23. It peaks this year on the night of July 28 and morning of July 29. The nearly full moon will be a problem this year, blocking out all but the brightest meteors. But if you are patient, you should still be able to catch a few good ones. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.

August 11 - **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 09:58 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.

August 11 - **Partial Solar Eclipse.** A partial solar eclipse occurs when the Moon covers only a part of the Sun, sometimes resembling a bite taken out of a cookie. A partial solar eclipse can only be safely observed with a special solar filter or by looking at the Sun's reflection. The partial eclipse will be visible in parts of northeast Canada, Greenland, extreme northern Europe, and northern and eastern Asia. It will be best seen in northern Russia with 68% coverage. (**NASA Map and Eclipse Information**)

August 12, 13 - **Perseids Meteor Shower.** The Perseids is one of the best meteor showers to observe, producing up to 60 meteors per hour at its peak. It is produced by comet Swift-Tuttle, which was discovered in 1862. The Perseids are famous for producing a large number of bright meteors. The shower runs annually from July 17 to August 24. It peaks this year on the night of August 12 and the morning of August 13. The thin crescent moon will set early in the evening leaving dark skies for what should be an excellent show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Perseus, but can appear anywhere in the sky.

August 17 - **Venus at Greatest Eastern Elongation.** The planet Venus reaches greatest eastern elongation of 45.9 degrees from the Sun. This is the best time to view Venus since it will be at its highest point above the horizon in the evening sky. Look for the bright planet in the western sky after sunset.

August 26 - **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 11:57 UTC. This full moon was known by early Native American tribes as the Full Sturgeon Moon because the large sturgeon fish of the Great Lakes and other major lakes were more easily caught at this time of year. This moon has also been known as the Green Corn Moon and the Grain Moon.

August 26 - **Mercury at Greatest Western Elongation.** The planet Mercury reaches greatest western elongation of 18.3 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the morning sky. Look for the planet low in the eastern sky just before sunrise.

Clear Skies
Andy

***The 2018 Perseids** will peak on the night of August 12 and early morning hours of August 13. A New Moon creates dark skies and excellent conditions to see the shooting stars.*

When Can I See the Perseids?

The Perseid meteor shower, one of the brighter meteor showers of the year, occurs every year between July 17 and August 24. The shower tends to peak around August 9-13.

Peak dates: Sun, 12 Aug–Mon, 13 Aug

All times shown are local times. Use the **Select night** drop-down menu above the animation to select other dates. Click on the **Peak dates** link above the animation to select the night when the meteor shower peaks. Press the play button to see how the radiant will move across the sky through the night with respect to your position on the ground. Alternatively, you can rotate the sky manually by using your mouse or touchpad. Clicking on the red arrow will take you back to the radiant.

During the nights of meteor shower activity, the animation automatically shows the real-time position of the radiant. Clicking the **LIVE** button, changing dates, or manually rotating the sky will take you out of the live mode.

The animation is representative; it does not show the exact numbers of meteors visible at any given time. You could see more or fewer shooting stars depending on the level of meteor shower activity.

The best time to view the Perseids, and most other meteor showers, is when the sky is the darkest. Most astronomers suggest that depending on the Moon's phase, the best time to view meteor showers is right before dawn.

Comet Swift-Tuttle

Made of tiny space debris from the comet Swift-Tuttle, the Perseids are named after the constellation Perseus. This is because the direction, or radiant, from which the shower seems to come in the sky lies in the same direction as the constellation Perseus, which can be found in the north-eastern part of the sky.

While the skies are lit up several times a year by other meteor showers, the Perseids are widely sought after by astronomers and stargazers. This is because, at its peak, one can see 60 to 100 meteors in an hour from a dark place.

Where Can I See the Perseids?

The Perseids can be seen in the Northern Hemisphere. Look between the radiant, which will be in the north-east part of the sky, and the zenith (the point in the sky directly above you).

While you can easily see a shooting star with the naked eye just looking straight up, the table below shows the exact direction of the Perseids from your location.

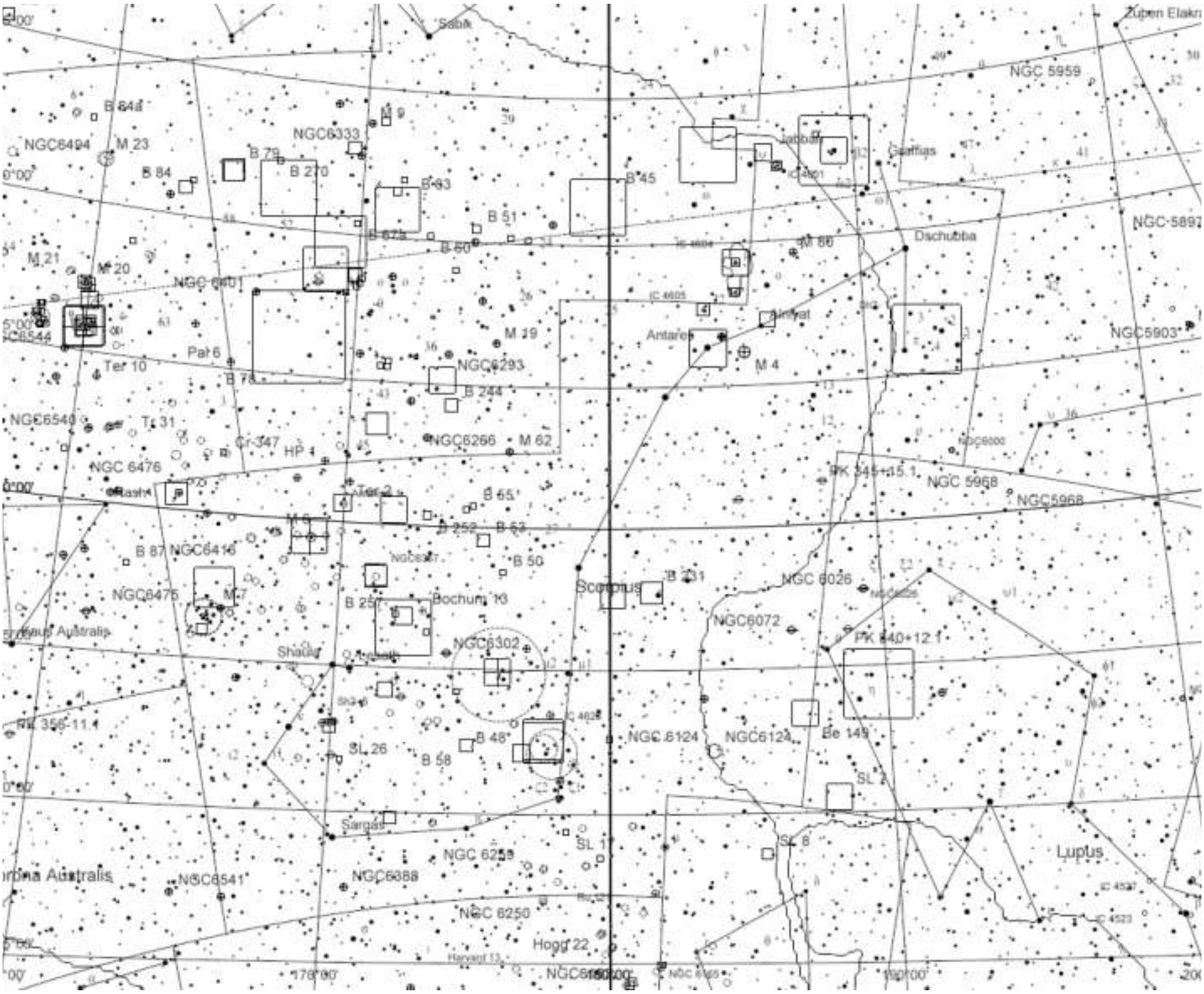
How to Watch Meteor Showers

Check the weather: Meteors, or shooting stars, are easy to spot. All you need is clear skies and a pair of eyes.

Get out of town: Find a place as far away as possible from artificial lights.

Prepare to wait: Bring something to sit or lie down on. Star gazing is a waiting game, so get comfortable.

CONSTELLATIONS OF THE MONTH: SCORPIO



The zodiacal constellation of Scorpius resides on the ecliptic plane and was one of the original 48 constellations charted by Ptolemy to be later adopted as a modern constellation by the IAU. It covers 497 square degrees of sky and ranks 33rd in size. Scorpius has 15 main stars in its asterism and 47 Bayer Flamsteed designated stars within its confines. It is bordered by the constellations of Sagittarius, Ophiuchus, Libra, Lupus, Norma, Ara and Corona Australis. Scorpius is visible to all observers located at latitudes between +40° and ?90° and is best seen at culmination during the month of July.

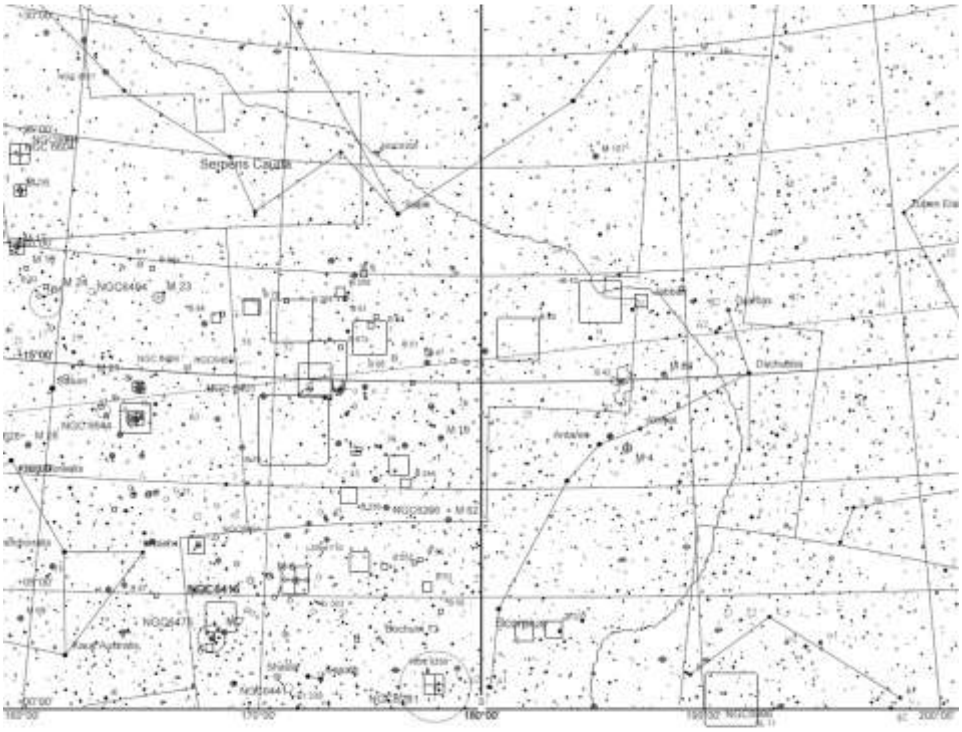
There are two annual meteor showers associated with the constellation of Scorpius. The first is the Alpha Scorpiids – which begin on or about April 16 and end around May 9. The peak date of most activity is on or about May 3 and the radiant is near the brilliant red star, Antares. The second meteor shower, the June Scorpiids peaks on or about June 5 of each year. The radiant for this particular meteor shower is closer to the Ophiuchus border and the activity rate on the peak date is high – with about 20 meteors (average) per hour and many reported fireballs.

Because Scorpius was easy visible to ancient civilizations and its patterns do resemble the Scorpion which it represents, there is a great deal of mythology associated with this constellation. To the Greeks it represented the creature sent by Hera to eliminate Orion the Hunter – forever kept apart in the sky to continue their heavenly feud. Perhaps it was Apollo who sent the Scorpion and Orion flees it? Scorpius was also said to appear to Phaethon, who wrecked the sun-chariot when the horses balked at the mighty monster's appearance. The Oriental culture recognized this pattern of stars as part of the Dragon, while the Polynesians saw it as a fishhook. No matter what legend you choose to place on this pattern of stars, its curving asterism is very distinctive and easy to recognize!

Let's begin our binocular tour of Scorpius with its brightest star – Alpha – the "a" symbol on our chart. Antares is part of the Upper Scorpius Association of Stars and is no doubt also a star poised on the edge of extinction. At a safe distance of 500 light-years, you'll find this pulsating red variable equally fascinating to the eye as well as to the telescope. Unlike other stars, Alpha Scorpii also has a companion which can be revealed to small telescopes under steady conditions. Discovered on April 13, 1819 during a lunar occultation, this 6.5 magnitude green companion isn't the easiest to split from such a bright primary – but it's certainly fun to try to spot its 5.4 magnitude green companion. Like winter's Sirius, the Antares pair needs especially still – but not necessarily dark – skies. It also requires a well-chosen magnification – one high enough to separate the two close stars (2.9 arc seconds), but low enough to concentrate the fainter star's (magnitude 5.4) light. Did you know that Antares' true rival is brighter Betelgeuse? Photometric measurements show that more massive Betelgeuse is slightly redder than Antares. Fortunately, the "Rival" does reside along the ecliptic plane allowing us many opportunities to see it accompany other solar system objects and be occulted by the Moon!

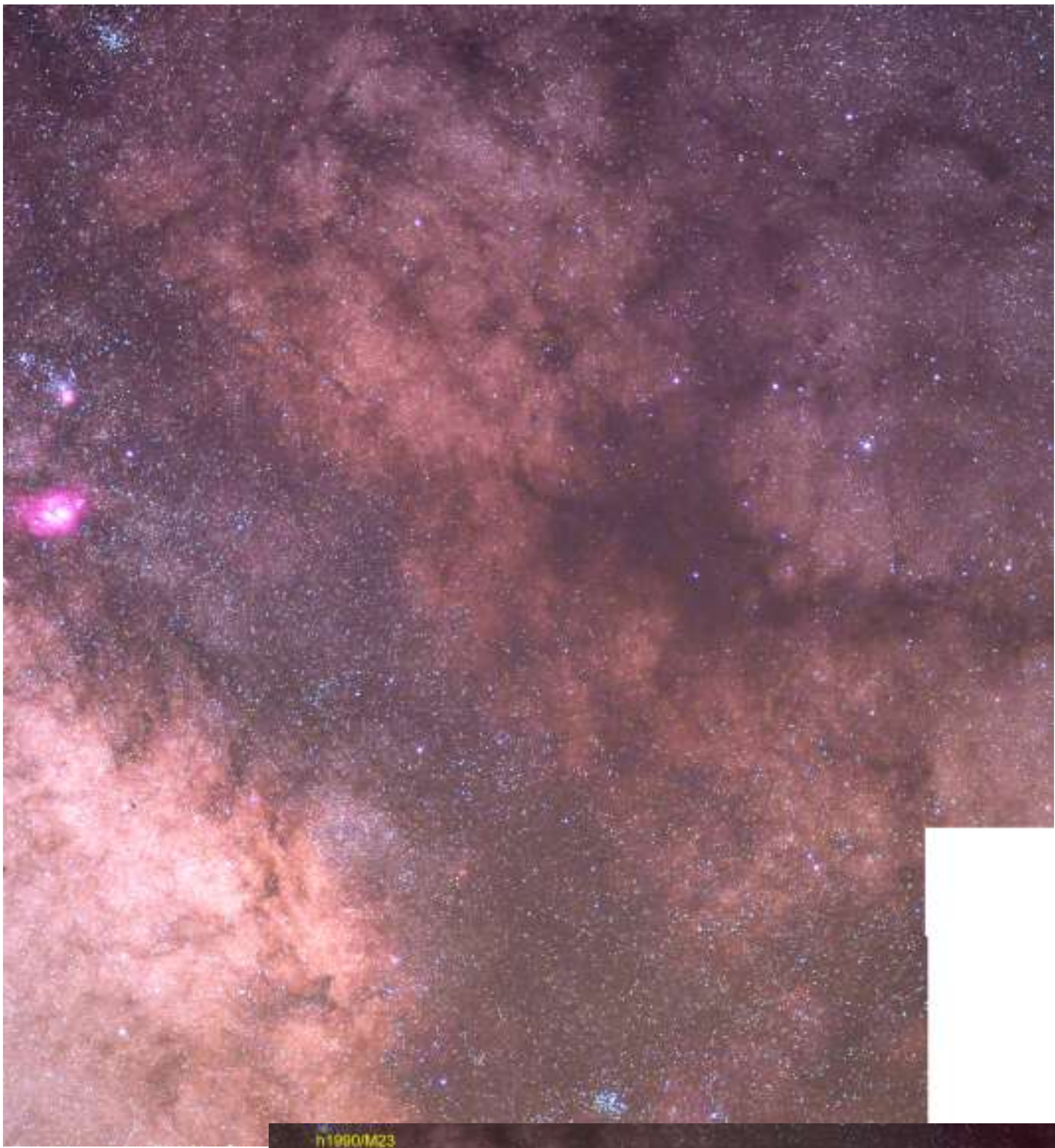
Keep your binoculars handy because all you have to know is Antares and go west…

Just slightly more than a degree away you'll find a major globular cluster perfectly suited for every size telescope and bin-



This is Scorpio as seen from Wiltshire Mid July at 10:30pm when it is due south. Note we will miss the loop of the tail at the bottom of the constellation.

oculars – M4 (RA 16 23 35 Dec 26 31 31). This 5th magnitude Class IX cluster can even be spotted unaided from a dark location! In 1746 Philippe Loys de Cheseaux happened upon this 7200 light-year distant beauty – one of the nearest to us. It was also included in Lacaille's catalog as object I.9 and noted by Messier in 1764. Much to Charles' credit, he was the first to resolve it!
As one of the loosest globular clusters, M4 would be tremendous if we were not looking at it through a heavy cloud of interstellar dust. To binoculars, it is easy to pick out a very round, diffuse patch – yet it will begin resolution with even a small telescope. Large telescopes will also easily see a central "bar" of stellar concentration across M4's core region, which was first noted by William Herschel. As an object of scientific study, the first millisecond pulsar was discovered within M4 in 1987 – one which spins 10 times faster than the Crab Nebula pulsar. Photographed by the Hubble Space Telescope in 1995, M4 was found to contain white dwarf stars – the oldest in our galaxy – with a planet orbiting one of them! A little more than twice the size of Jupiter, this planet is believed to be as old as the cluster itself. At 13 billion years, it would be three times the age of the Sol system!
Keep your binoculars or a small telescope handy as well go off to explore a single small globular cluster – Messier 80. Located about 4 degrees northwest of Antares (half a fist), this little globular cluster is a powerpunch. Located in a region heavily obscured by dark dust, the M80 will shine like an unresolvable star to small binoculars and reveal itself to be one of the most heavily concentrated globulars to the telescope. Discovered within days of each other by Messier and Mechain respectively in 1781, this intense cluster is around 36,000 light years distant.
In 1860, the M80 became the first globular cluster to contain a nova. As stunned scientists watched, a centrally located star brightened to magnitude 7 over a period of days and became known as T Scorpii. The event then dimmed more rapidly than expected, making observers wonder exactly what they had seen. Since most globular clusters contain stars all of relatively the same age, the hypothesis was put forward that perhaps they had witnessed an actual collision of stellar members. Given the cluster contains more than a million stars, the probability remains that some 2700 collisions of this type may have occurred during the M80's lifetime.
Now head for Lambda Scorpii and hop three fingerwidths northeast to NGC 6406 (RA 17 40 18 Dec -32 12 00)… We're hunting the "Butterfly!" Easily seen in binoculars and tremendous in the telescope, this brilliant 4th magnitude open cluster was discovered by Hodierna before 1654 and independently found by de Cheseaux as his Object 1 before being cataloged by Messier as M6. Containing about 80 stars, the light you see tonight left its home in space around the year 473 AD. Messier 6 is believed to be around 95 million years old and contains a single yellow supergiant – the variable BM Scorpii. While most of M6's stars are hot, blue, and belong to the main sequence, the unique shape of this cluster gives it not only visual appeal, but wonderful color contrast as well.
Less than 3 arc minutes east of 3.3 magnitude G Scorpii (the tail star of the Scorpion) is 7.4 magnitude globular cluster NGC 6441. No challenge here. This 38,000 light-year distant compact cluster is around 13 thousand light-years from the galactic core. It was first noted by James Dunlop from south-eastern Australia in 1826.
Around two and a half degrees northeast of G Scorpii (and NGC 6441) is another interesting deep sky twosome – bright open cluster M7 and faint globular NGC 6453. M7 was first recorded as a glowing region of faint stars by Ptolemy circa 130 CE. Located 800 light-years away, the cluster includes more than half a dozen 6th magnitude stars easily resolved with the least amount of optical aid. Through telescopes, as many as 80 various stars can be seen and it rocks in binoculars!
Now head northeast and the faint haze of 31,000 light-year distant globular cluster NGC 6453 will reveal itself to mid- and large-sized scopes. Like NGC 6441, this globular cluster was discovered from the southern hemisphere, in this case by John Herschel on June 8, 1837 while observing from the Cape of Good Hope, South Africa.
It's time to aim your telescope at NGC 6302, a very curious planetary nebula located around three fingerwidths west of Lambda Scorpii: it is better known as the "Bug" nebula (RA 17 13 44 Dec -37 06 16). With a rough visual magnitude of 9.5, the Bug belongs to the telescope – but it's history as a very extreme planetary nebula belongs to us all. At its center is a 10th magnitude star, one of the hottest known. Appearing in the telescope as a small bowtie, or figure 8 shape, huge amounts of dust lie within it – very special dust. Early studies showed it to be composed of hydrocarbons, carbonates and iron. At one time, carbonates were believed associated with liquid water, and NGC 6302 is one of only two regions known to contain carbonates – perhaps in a crystalline form.
Ejected at a high speed in a bi-polar outflow, further research on the dust has shown the presence of calcite and dolomite, making scientists reconsider the kind of places where carbonates might form. The processes that formed the Bug may have begun 10,000 years ago – meaning it may now have stopped losing material. Hanging out about 4000 light-years from our own solar system, we'll never see NGC 6302 as well as the Hubble Telescope presents its beauty, but that won't stop you from enjoying one of the most fascinating of planetary nebulae!
Now begin your starhop at the colorful southern Zeta pair and



head north less than one degree for NGC 6231 (RA 16 : 54.0 Dec -41 : 48). Wonderfully bright in binoculars and well resolved to the telescope, this tight open cluster was first discovered by Hodierna before 1654. De Cheseaux cataloged it as object 9, Lacaille as II.13, Dunlop as 499, Melotte as 153, and Collinder as 315. No matter what catalog number you chose to put in your notes, you'll find the 3.2 million year young cluster shining as the "Northern Jewelbox!" For high power fans, look for the brightest star in this group – it's van den Bos 1833, a splendid binary. About another degree north is loose open cluster Collinder 316, with its stars scattered widely across the sky. Caught on its eastern edge is another cluster known as Trumpler 24, a site where new variables might be found. This entire region is encased in a faint emission nebula called IC 4628 – making this low power journey through southern Scorpius a red hot summer treat!

When you are done, hop west (RA 16 25 18 Dec 40 39 00) to encounter the fine open cluster NGC 6124. Discovered by Lacaille and known to him as object I.8, this 5th magnitude open cluster is also known as Dunlop 514, as well as Melotte 145 and Collinder 301. Situated about 19 light-years away, it will show as a fine, round, faint spray of stars to binoculars and be resolved into about 100 stellar members to larger telescopes. While NGC 6124 is on the low side for northern observers, it's worth the wait for it to hit its best position. Be sure to mark your notes, because this delightful galactic cluster is a Caldwell object and a southern skies binocular reward!

There are many, many more splendid object to be discovered in the constellation of Scorpius, so be sure to get a detailed star chart and enjoy!

ISS PASSES For Summer 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.
06 Jul	-1.5	03:39:11	10°	S	03:40:50	13°	SE	03:42:30	10°	ESE
08 Jul	-2.3	03:29:50	15°	SSW	03:31:44	23°	SSE	03:34:25	10°	E
09 Jul	-1.8	02:39:00	15°	SSE	02:39:18	15°	SE	02:41:19	10°	ESE
09 Jul	-3.6	04:12:02	10°	WSW	04:15:15	55°	SSE	04:18:29	10°	E
10 Jul	-3.1	03:20:43	19°	SW	03:22:40	39°	SSE	03:25:46	10°	E
11 Jul	-2.7	02:29:47	26°	SSE	02:30:09	26°	SSE	02:32:57	10°	E
11 Jul	-3.9	04:03:02	10°	WSW	04:06:19	78°	SSE	04:09:36	10°	E
12 Jul	-1.7	01:38:49	15°	ESE	01:38:49	15°	ESE	01:39:55	10°	E
12 Jul	-3.8	03:11:24	18°	WSW	03:13:40	61°	SSE	03:16:54	10°	E
13 Jul	-3.4	02:20:23	37°	S	02:21:02	43°	SSE	02:24:10	10°	E
13 Jul	-3.8	03:54:05	10°	W	03:57:22	87°	N	04:00:40	10°	E
14 Jul	-2.5	01:29:18	26°	ESE	01:29:18	26°	ESE	01:31:22	10°	E
14 Jul	-3.9	03:01:53	14°	WSW	03:04:40	83°	SSE	03:07:57	10°	E
15 Jul	-1.3	00:38:09	11°	E	00:38:09	11°	E	00:38:22	10°	E
15 Jul	-3.9	02:10:44	34°	SW	02:11:57	66°	SSE	02:15:13	10°	E
15 Jul	-3.8	03:45:06	10°	W	03:48:23	85°	N	03:51:42	10°	E
16 Jul	-3.6	01:19:31	47°	SE	01:19:31	47°	SE	01:22:27	10°	E
16 Jul	-3.8	02:52:21	10°	W	02:55:39	86°	N	02:58:56	10°	E
17 Jul	-2.2	00:28:09	21°	ESE	00:28:09	21°	ESE	00:29:37	10°	E
17 Jul	-4.0	02:00:43	20°	W	02:02:53	87°	S	02:06:10	10°	E
17 Jul	-3.9	03:36:04	10°	W	03:39:22	83°	SSW	03:42:39	10°	ESE
17 Jul	-1.4	23:36:31	11°	E	23:36:31	11°	E	23:36:40	10°	E
18 Jul	-4.0	01:09:03	38°	WSW	01:10:08	72°	SSE	01:13:25	10°	E
18 Jul	-3.9	02:43:18	10°	W	02:46:36	87°	N	02:49:53	10°	E
18 Jul	-3.5	04:19:47	10°	W	04:22:56	44°	SSW	04:26:05	10°	SE
19 Jul	-3.8	00:16:11	31°	SW	00:17:24	53°	SSE	00:20:37	10°	E
19 Jul	-3.9	01:50:31	10°	W	01:53:49	85°	N	01:57:06	10°	E
19 Jul	-3.9	03:26:59	10°	W	03:30:14	61°	SSW	03:33:29	10°	ESE
19 Jul	-3.4	23:21:40	10°	SW	23:24:43	37°	SSE	23:27:47	10°	E
20 Jul	-3.9	00:57:43	10°	W	01:01:00	90°	SSE	01:04:17	10°	E
20 Jul	-4.0	02:34:12	10°	W	02:37:29	79°	SSW	02:40:45	10°	ESE
20 Jul	-2.8	04:10:50	10°	W	04:13:39	27°	SSW	04:16:27	10°	SSE
20 Jul	-2.8	22:29:19	10°	SSW	22:32:04	25°	SSE	22:34:50	10°	E
21 Jul	-4.0	00:04:56	10°	WSW	00:08:12	77°	SSE	00:11:30	10°	E
21 Jul	-3.9	01:41:23	10°	W	01:44:40	89°	N	01:47:58	10°	E
21 Jul	-3.4	03:17:53	10°	W	03:20:59	39°	SSW	03:24:04	10°	SE
21 Jul	-3.9	23:12:12	10°	WSW	23:15:26	59°	SSE	23:18:40	10°	E
22 Jul	-3.9	00:48:33	10°	W	00:51:51	84°	N	00:55:08	10°	E
22 Jul	-3.8	02:25:01	10°	W	02:28:15	56°	SSW	02:31:28	10°	ESE
22 Jul	-2.2	04:02:09	10°	WSW	04:04:12	16°	SW	04:06:15	10°	S
22 Jul	-3.4	22:19:35	10°	SW	22:22:41	41°	SSE	22:25:48	10°	E
22 Jul	-3.9	23:55:43	10°	W	23:59:01	88°	N	00:02:17	10°	E
23 Jul	-4.0	01:32:12	10°	W	01:35:28	74°	SSW	01:35:57	59°	SE
23 Jul	-4.0	23:02:54	10°	WSW	23:06:10	81°	SSE	23:09:27	10°	E
24 Jul	-4.0	00:39:21	10°	W	00:42:38	88°	S	00:43:45	38°	E
24 Jul	-1.4	02:15:52	10°	W	02:16:18	13°	W	02:16:18	13°	W
24 Jul	-3.9	22:10:06	10°	WSW	22:13:21	64°	SSE	22:16:36	10°	E
24 Jul	-3.9	23:46:29	10°	W	23:49:47	85°	N	23:52:08	18°	E
25 Jul	-2.4	01:22:57	10°	W	01:24:42	27°	W	01:24:42	27°	W

24 Jul	-4.0	00:39:21	10°	W	00:42:38	88°	S	00:43:45	38°	E
24 Jul	-1.4	02:15:52	10°	W	02:16:18	13°	W	02:16:18	13°	W
24 Jul	-3.9	22:10:06	10°	WSW	22:13:21	64°	SSE	22:16:36	10°	E
24 Jul	-3.9	23:46:29	10°	W	23:49:47	85°	N	23:52:08	18°	E
25 Jul	-2.4	01:22:57	10°	W	01:24:42	27°	W	01:24:42	27°	W
25 Jul	-3.8	22:53:37	10°	W	22:56:54	86°	N	23:00:11	10°	E
26 Jul	-4.0	00:30:05	10°	W	00:33:16	69°	SSW	00:33:16	69°	SSW
26 Jul	-3.9	22:00:44	10°	WSW	22:04:01	85°	S	22:07:18	10°	E
26 Jul	-4.0	23:37:12	10°	W	23:40:29	85°	S	23:41:56	31°	ESE
27 Jul	-1.5	01:13:45	10°	W	01:14:30	15°	W	01:14:30	15°	W
27 Jul	-3.8	22:44:18	10°	W	22:47:35	86°	N	22:50:37	12°	E
28 Jul	-3.0	00:20:47	10°	W	00:23:12	38°	WSW	00:23:12	38°	WSW
28 Jul	-3.8	21:51:24	10°	W	21:54:40	85°	N	21:57:58	10°	E
28 Jul	-3.9	23:27:52	10°	W	23:31:06	64°	SSW	23:31:56	43°	SE
29 Jul	-3.9	22:34:56	10°	W	22:38:13	81°	SSW	22:40:41	16°	ESE
30 Jul	-2.1	00:11:32	10°	W	00:13:16	22°	WSW	00:13:16	22°	WSW
30 Jul	-3.8	21:42:00	10°	W	21:45:18	88°	NNE	21:48:34	10°	E
30 Jul	-3.3	23:18:29	10°	W	23:21:36	41°	SSW	23:22:03	39°	S
31 Jul	-3.7	22:25:31	10°	W	22:28:44	59°	SSW	22:30:50	20°	SE
01 Aug	-1.4	00:02:32	10°	W	00:03:26	14°	WSW	00:03:26	14°	WSW
01 Aug	-3.8	21:32:33	10°	W	21:35:50	77°	SSW	21:39:06	10°	ESE
01 Aug	-2.5	23:09:12	10°	W	23:11:58	25°	SSW	23:12:15	25°	SSW
02 Aug	-3.0	22:16:05	10°	W	22:19:09	37°	SSW	22:21:05	19°	SSE
03 Aug	-1.7	23:00:16	10°	WSW	23:02:10	15°	SW	23:02:33	14°	SSW
04 Aug	-2.1	22:06:47	10°	W	22:09:24	23°	SW	22:11:27	13°	SSE
06 Aug	-1.3	21:57:56	10°	WSW	21:59:32	13°	SW	22:01:06	10°	SSW
30 Aug	-1.0	05:33:00	10°	SSE	05:34:05	11°	SE	05:35:09	10°	ESE
01 Sep	-1.7	05:21:03	10°	SSW	05:23:30	20°	SE	05:25:59	10°	E
02 Sep	-1.3	04:29:20	11°	SSE	04:30:25	13°	SE	04:31:56	10°	ESE
03 Sep	-2.6	05:10:47	15°	SSW	05:12:59	33°	SSE	05:15:58	10°	E
04 Sep	-2.1	04:19:35	22°	SSE	04:19:47	22°	SE	04:22:22	10°	E
05 Sep	-0.8	03:28:20	10°	ESE	03:28:20	10°	ESE	03:28:27	10°	ESE
05 Sep	-3.4	05:00:55	25°	SW	05:02:30	52°	SSE	05:05:42	10°	E
06 Sep	-2.7	04:09:38	34°	SE	04:09:38	34°	SE	04:12:14	10°	E
06 Sep	-3.8	05:42:12	10°	W	05:45:26	89°	S	05:48:43	10°	E
07 Sep	-0.8	03:18:19	12°	E	03:18:19	12°	E	03:18:39	10°	E
07 Sep	-3.9	04:50:54	37°	WSW	04:52:02	75°	SSE	04:55:18	10°	E
08 Sep	-2.7	03:59:34	39°	ESE	03:59:34	39°	ESE	04:01:52	10°	E
08 Sep	-3.8	05:32:09	13°	W	05:35:01	84°	N	05:38:18	10°	E
09 Sep	-0.6	03:08:15	11°	E	03:08:15	11°	E	03:08:23	10°	E
09 Sep	-3.9	04:40:49	51°	W	04:41:33	89°	NNW	04:44:51	10°	E
10 Sep	-2.2	03:49:30	31°	E	03:49:30	31°	E	03:51:23	10°	E
10 Sep	-3.9	05:22:05	17°	W	05:24:32	90°	W	05:27:49	10°	E
11 Sep	-4.0	04:30:48	73°	WNW	04:31:04	85°	N	04:34:21	10°	E

END IMAGES, OBSERVING AND OUTREACH

Summer is coming, and with it the Milky Way will be visible in the first darkening of the skies, especially from July onwards.

Here is the Milky Way taken from a vantage point above the English Channel (Grange Hill road car park above Kimmeridge Bay.

The cloud whisped through to the left of the Milky Way.

Full frame DSLR (Nikon D810a) with wide angle lens 14mm f2 Samyang.

This car park just put a hill and firing range to cover the Weymouth lights, and is just south of the Poole and Bournemouth conglom-eration so the darkest skies are possible. ISO640, 30seconds exposure.

Wiltshire Astronomical Society Observing Sessions 2017 – 2018		
Date	**Moon Phase**	**Observing Topic**
2018		
August tba	Slim Crescent	Perseid Meteor Shower