JANUS
THE NEWSLETTER OF EWELL ASTRONOMICAL SOCIETY

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Editorial

Welcome to the November edition of Janus. This month's meeting will be on Friday 11th November when Dr Steve Fossey from UCL will give us a talk on 'Extrasolar Planets'. By way of advance warning, there will be no December lecture; instead, our AGM (with quiz!) will be held on Friday 9th December

The mixed fortunes of NASA's 2 major missions (Artemis-1 and DART) continued into October with the latest launch attempt of Artemis 1 now planned for 14th November. More positively, NASA confirmed that DART's successful impact with the asteroid Dimorphos on 27th September changed Dimorphos' orbit around its bigger companion asteroid Didymos by more than 30 minutes, far exceeding the original goal.

By any measure, DART has been a huge success, making a bullseye impact on its target and showing that missions like this can alter the trajectories of asteroids. Whilst the idea has been around for a long time, only now have engineering and science caught up. In the future, if an asteroid is found to be on a collision path with Earth, and we have enough warning, a next-generation mission based on the DART experience could well save Earth and humanity from significant losses.

A more extensive piece on this remarkable mission is at:
https://theconversation.com/nasas-asteroid-deflection-mission-was-more-successful-than-expected-an-expert-explains-how-192334

Finally, a recent study (see later in this issue) suggests that 2.5 billion years ago, a day was roughly 17 hrs long rather than the current 24 hrs – how many days in a year in wonder!!

John

SkyUpdate
What's up this month?

The Solar System November

MERCURY: begins the month soon passing behind the Sun and is not readily observable since it is very close to the Sun, at a separation of only 4° from it. By the end of the month, having recently passed behind the Sun at superior solar conjunction, it remains difficult to see, reaching its highest point in the sky during daytime and being 1° below the horizon at dusk.

VENUS: recently passed behind the Sun at superior solar conjunction. At the beginning of the month, it is not readily observable, since it is very close to the Sun, at a separation of only 2° from it. By the end of the month, it remains difficult to observe, reaching its highest point in the sky during daytime and being level with the horizon at dusk.

MARS: is currently approaching opposition and is visible throughout the month as a morning object. It begins the month becoming accessible around 19:46 UT, when it reaches an altitude of 7° above the NE horizon. It will then reach its highest point in the sky at 02:58, 62° above the S horizon, before being lost to dawn twilight around 06:29, 41° above the W horizon. At the end of the month, it becomes accessible around 17:18 UT, when it reaches an altitude of 7° above the NE horizon. reaching its highest point in the sky at 00:36, 63° above the S horizon, it will be lost to dawn twilight around 07:15, 13° above the NW horizon.

JUPITER: recently passed opposition and begins the month visible in the evening sky, becoming accessible around 16:56 UT, 13° above the E horizon, as dusk fades to darkness. It will then reach its highest point in the sky at 21:16, 36° above the S horizon, and will continue to be observable until around 02:16, when it sinks below 7° above the W horizon. By the end of the month, as an early evening object, it is visible in the evening sky, becoming accessible around 16:20 UT, 24° above the SE horizon, as dusk fades to darkness. Reaching its highest point in the sky at 19:19, 36° above the S horizon, it will continue to be observable until around 00:17, when it sinks below 7° above the W horizon.

SATURN: is currently an early evening object, now receding into evening twilight. It begins the month visible in the evening sky, becoming accessible around 17:15 UT, 19° above the S horizon, as dusk fades to darkness. It will then reach its highest point in the sky at 18:41, 22° above the S horizon, and will continue to be observable until around 21:47, when it sinks below 10° above the SW horizon. At the end of the month, still visible in the evening sky, it becomes accessible around 16:43 UT, 22° above the S horizon, as dusk fades to darkness. Reaching its highest point in the sky shortly after at 16:51, 22° above the S horizon, it will continue to be observable until around 19:59, when it sinks below 11° above the SW horizon.

URANUS: begins the month approaching opposition and is visible as a morning object. Becoming accessible around 19:12, when it rises to an altitude of 21° above the E horizon, it will reach its highest point in the sky at 00:18, 55° above the S horizon. It will become inaccessible around 05:23 when it sinks below 21° above the W horizon. At month's end, having recently passed opposition, it is visible in the evening sky, becoming accessible around 17:23 UT 23° above the E horizon, as dusk fades to darkness. Reaching its highest point in the sky at 22:15, 54° above the S horizon, it will continue to be observable until around 03:19, when it sinks below 21° above the W horizon.

NEPTUNE: is currently an early evening object, and begins the month visible in the evening sky, becoming accessible around 17:55 UT, 23° above the SE horizon, as dusk fades to darkness. It will then reach its highest point in the sky at 20:51, 34° above the S horizon, and will continue to be observable until around 23:56, when it sinks below 21° above the SW horizon. By the end of the month, still an early evening object, but now receding into evening twilight, it becomes accessible around 17:23 UT, 31° above the SE horizon, as dusk fades to darkness. It will then reach its highest point in the sky at 18:56, 34° above the S horizon, and continue to be observable until around 22:00, when it sinks below 21° above the SW horizon.

MOON PHASES:

First Quarter	1 Nov
Full Moon	8 Nov
Last Quarter	16 Nov
New Moon	23 Nov
First Quarter	30 Nov

Notable Events:

Observation of some of these events may require a telescope, although some will be visible with the naked eye. More information with times at https://in-the-sky.org

November

1	Close approach of the Moon and Saturn
4	Close approach of the Moon and Jupiter
8	Close approach of the Moon and Uranus
9	Uranus at opposition
11	Close approach of the Moon and Mars
12	Asteroid 27 Euterpe at opposition Northern Taurid meteor shower 2022
18	Leonid meteor shower 2022 M45 is well placed
19	Asteroid 115 Thyra at opposition
21	α-Monocerotid meteor shower 2022
22	Asteroid 324 Bamberga at opposition
23	Jupiter ends retrograde motion
24	118P/Shoemaker-Levy at perihelion
28	November Orionid meteor shower 2022
29	Close approach of the Moon and Saturn Asteroid 30 Urania at opposition

Collected Observations (and thoughts) – Gary Walker

Observations – 2 Oct

On the late evening of 2nd October, around 10.45pm, I observed the Galilean Moon of Io, very close to the limb of Jupiter. Later, it had disappeared onto Jupiter itself and, by about 11.25pm, I could see the shadow of Io on the limb of Jupiter – at first, only about half on!

Over the next hour and a half, I watched the shadow of Io (known as a Shadow Transit), inch its way across Jupiter, straight along the Southern Equatorial Belt. As usual, these are conspicuous, appearing as jet black spots projected upon Jupiter.

I observed it mostly at 222X, but I could also see it at 100X. By about 1am, the shadow was over two-thirds of the way across Jupiter.

I then observed Mars and saw that it was now much brighter than the orange star of Aldeberan, which was not far away! At 222X, I could easily see a dark feature on Mars. By using the Sky and Telescope Mars Profiler Tool, I could see that this feature was Mare Erythraeum.

Mars was now 12' arcseconds in size, which is not very large, especially after seeing Jupiter's 49' arcseconds size, but it IS quite large for Mars, especially when you consider that Mars spends most of its time at about only 4' arcseconds!

Mars – 15 October

Once again, the ancient tradition of the sky clearing after an EAS meeting happened on 14th October. Later that evening I observed Mars, which was in a conjunction with the waning gibbous Moon only about 4 degrees from it, which made a beautiful sight.

Through my telescope, I could see a large dark feature - Syrtis Major, the most conspicuous dark feature on Mars - well placed! I observed with magnifications of 222X and 333X. The feature appears as a triangular shape with a "hump", and two "prongs". I could see it even with the 100X eyepiece, and just about, with the 62X power, too.

Mars was 13.3' arcseconds in size, which is virtually the size that it attains at its most distant oppositions from Earth. However, it was now appearing “big enough” for details on it to be visible in my telescope. I have managed, in the past, to detect dark features, when Mars was only about 5.7' arcseconds in size!

At opposition in December, it will reach up to 17' arcseconds in size, which is smaller than the last two oppositions of 24' arcseconds and 20' arcseconds, but is still fairly good, for Mars.

Mars is notoriously hard to observe as, for at least a year, it is too close to the Sun to be observed, or else is only visible in the early morning sky! Even then, it is not really worth observing, as it is only about 4' arcseconds in size - scarcely bigger than Uranus! For most of its two-year orbit, Mars is under 10' arcseconds in size. Hence, for only a few months, either side of opposition, is Mars relatively easy to observe!

I have read in older astronomical books that Mars is only worth observing when it is 10' arcseconds or greater in size, but recent books suggest that it is worth observing once it reaches 6' arcseconds in size. This must be due to better telescopes, and especially the ability of amateurs to image the planet and record details on it, even at its most distant from Earth!

Amateurs like Damien Peach have done wonders in imaging planets, far rivalling photographs taken with the 200" Palomar Telescope in the 1950's, and 1960's. This is because they can stack multiple images that they obtain, allowing them to counteract the blurring effects of the Earth's atmosphere.

Jupiter was still magnificent, being the brightest "star" in the sky, in the evenings.

The Square of Pegasus – 15 Oct

In the last meeting, the "Sky at Night" talk was based around the Square of Pegasus. It is possible to assess how dark your sky is by seeing how many stars you can see within the Square. From my garden, I could see a total of 5 stars, but in a truly dark sky, up to 20 stars are visible!

It is said that if only 0-2 stars are visible, conditions are "poor", and 3-7 stars is rated "average" (i.e. my area). If you can see 8-11 stars, it means conditions are "good" and if 12 or more stars are visible, then your sky is "excellent"!

The easiest stars to see, are a close pair of magnitude 4.4 ones, (Upsilon Pegasi and Tau Pegasi), whilst the others are more difficult. Based on this observation, I worked out that my sky is a Bright Suburban Sky - No 6 on the Bortle Dark Sky chart. Given that my "limiting magnitude" is about 5.5, my sky is far from perfect, but better than many!

Partial Solar Eclipse – 25 Oct

I saw most of the Partial Solar Eclipse on 25th October. The eclipse times from London were:

- First Contact (i.e. start) 10.08 am BST.
- Maximum eclipse at 10.59 am.
- Second Contact (i.e. end) at 11.51am.

I first thought that I could see a distortion in the Sun's limb at about 10.09 am. Initially, I wasn't sure if it was the start as, at this point, it was such a shallow. After only about 3 minutes, however, it was a clear curve into the Sun.

The eclipse became a long curve into the Sun's limb (the "top" limb), which gradually moved around to the left-hand limb.

At maximum eclipse, at 10.59 am, the eclipse magnitude was 25%, and the eclipse obscuration was 15%.

The weather had started off very sunny and clear, with only a few cirrus patches, (i.e. a typical "Bright Start" morning), but some cumulus clouds started to come in at about 10.40 am. I was still able to see the eclipse past 11 am but, by about 11.15am or so, it had effectively become overcast, with even a bit of drizzle starting. Appearances of the Sun became rarer, and I last saw the eclipse at 11.30 am, just 21 minutes before the end of it. Despite this, as with last year's eclipse, the sight of the eclipsed Sun shining through the clouds, was quite atmospheric. Typically, the Sun eventually came out again, but by that time, the eclipse was over!

Despite the nuisance clouds, I would count this eclipse a success, as at least I managed to get good views of it (I remember at least 5 solar eclipses when it was completely overcast from start to finish, particularly, the one on 20th March 2015!)

It is really depressing when you can't see anything of an eclipse, especially as the Sun is so bright that, even in the grotty conditions that mean other astronomical observations cannot be carried out, an eclipse is still observable!

This eclipse was very similar to the last eclipse on 10th June 2021, with about the same amount of the Sun being eclipsed! I have now seen 13 solar eclipses in all, but over twice as many lunar eclipses. The period from 2021 up to 2027, sees a total of 5 solar eclipses visible from Britain. Given that I have known very lean periods of up to 10 years, with NO eclipses (i.e. 1984-1994),this present period is quite productive in terms of eclipses! Incidentally, this eclipse was not total, or annular, anywhere on Earth, only a bigger, or smaller partial, being seen. Russia saw the maximum eclipse at over 83% in all, but the Russians were no doubt too busy doing other things to observe it!

The Eclipse was shown on the BBC News, (inevitably, of course, as the final item!)

I was mostly observing the eclipse with my suitably filtered 8" SCT, especially when it started when, of course, the eclipse was still too small to be seen, except through a telescope, but before long it was easily visible in binoculars, as well as with the naked eye!

Ironically, when the Sun was in cloud, it was too dim to be seen with my telescope, but it was often visible with the naked eye, with the clouds acting as a filter.

On the following day, all but two of the national newspapers covered the eclipse and had photos, although none of the articles were extensive or detailed. The Express had a text article, but they couldn't even be bothered to include an image of it (how hard can it be to add a photo?!). Surprisingly, the Daily Star had about the biggest, and best, image of the eclipse. The Telegraph and Times also had good images. Notably, none of the eclipse images showed the deepest eclipse, as was seen in Eastern Europe.

Shadow Transits on Jupiter – 26 Oct

On the evening of 26th October, I could see a splendid demonstration of the movements of the Jupiter system. Just before 8pm, only 1 Galilean Moon (Callisto) was visible, well off to the West of Jupiter. By 9pm, I could see the shadow cast by Europa on Jupiter, and by 9.40pm, both Europa and Ganymede were casting their shadows upon Jupiter at the same time! By about 10.20pm, the two shadows were well placed on Jupiter, with Ganymede "following" Europa, whilst the actual Moons themselves had now left the disk and formed a close pairing to the West of the planet.

So, the two shadow transits formed a fine pair together, on the planet - an astronomical version of the "2 for 1" deal!

As Ganymede is the biggest moon, its shadow was considerably larger and blacker than that of Europa. It can give a 3D effect, as I have seen such shadows appearing to be above Jupiter (as indeed, they are!).

By about 11pm, the fourth moon, Io, had appeared close to the East of Jupiter.

I also saw the Great Red Spot at about 9pm, and I could just pick out an orange tinge to it.

Thus, it is possible to almost see action occurring in "real time", in the case of the Jovian Moons, as Galileo had found!

More Mars Observations – 27-30 - Oct

For Mars observers, I highly recommend the "Sky & Telescope Mars Profiler Tool", online, as it can show you exactly WHAT features are visible on Mars at the time that you have been observing it The site can even be flipped to match the type of telescope that you are using - Direct view, for scopes that give upright views, inverted view for Newtonian and Dobsonian telescopes, and even mirror reversed for SCT and MAC scopes!

This, at least, will stop people scratching their heads, wondering what they are actually seeing on a given night on Mars. The site also gives other information on Mars such as its current magnitude, angular size, etc.

On October 27th, Mars was now 14.7' arseconds, in size.

Ironically, Mars is now only a few degrees from the Orange stars, Aldeberan and Betelgeuse, although Mars is now significantly brighter than both of them! .They presently form a "triangle". Often, especially when Mars is low in the dawn sky, it is close to the Orange star Antares. In this situation, identifying Mars can be tricky, as it will have a tiny angular size at this time. Also, there are actually not that many bright orange stars, (i.e. Red Giants) in the sky anyway!

Object of the month – Jupiter

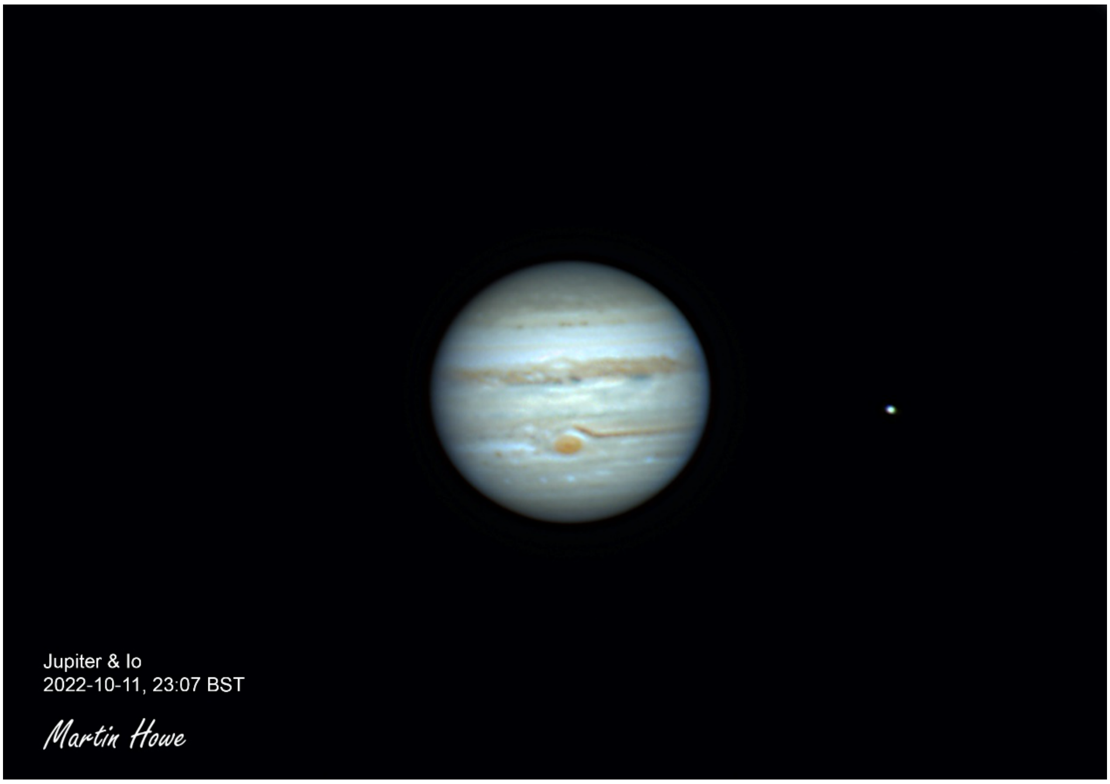
With Jupiter having recently passed opposition in late September, it is now placed as an easy object to view in the early darker evenings. At the beginning of November, Jupiter will be easy to find towards the Southeast, sitting at over 10 degrees altitude and shining at about magnitude –2.8 after sunset - by far and away the brightest object in the night sky barring the Moon.

By 7pm, Jupiter is nearly 30 degrees above the horizon, and crosses the meridian (that is, due south) at 37 degrees in altitude about 9:30pm.

It has been widely reported that Jupiter's great red spot (GRS) is slowly shrinking (for example, see *https://www.space.com/jupiter-great-red-spot-shrinking-thickness-steady.html*), but is still a prominent object and relatively easy to spot in a small telescope. Jupiter rotates very rapidly (about 10 hours) on its axis, contributing to a noticeable flattening of the sphere at the poles. As a result of this rapid rotation the GRS is only readily visible for about 2 hours either side of its mid-transit time, or in other words, hidden from view for about 6 hours at a time. The GRS transit times are widely published and so observations can be timed accordingly to try and observe or image it (subject to the weather of course!).

The other thing Jupiter is renowned for are the four bright Galilean moons – named collectively after Galileo who first observed them. These orbit Jupiter rapidly and their progress can be readily seen in binoculars or a telephoto lens (of at least 200mm focal length, but ideally 300 or 400mm). Occultations, eclipses, and transits of the moons (and their shadow transits) can also be readily observed and predicted timings are available online and in astronomy magazines.

The image below was taken on 2022-10-11 and shows the great red spot transiting the meridian, along with the inner Galilean moon Io.



How was this image taken?

This image was taken using a ZWO ASI294MC colour CMOS camera attached to a 127mm refractor with a 3x Barlow lens. A video sequence of 500 frames was captured and the best 250 frames were stacked in the freeware AutoStakkert. Sharpening was then performed in the freeware Registax, followed by some minor tweaks and cropping in Photoshop.

Our moon has been slowly drifting away from Earth over the past 2.5 billion years

Acknowledgement: This article was written by Joshua Davies, Professor, Sciences de la Terre et de l'atmosphère, Université du Québec à Montréal and Magriet Lantink, Postdoctoral Research Associate, Department of Geoscience, University of Wisconsin-Madison and was published in THE CONVERSATION on 10th October 2022. It is republished in full under a Creative Commons Licence.   The original article, with additional links can be found here: *https://theconversation.com/our-moon-has-been-slowly-drifting-away-from-earth-over-the-past-2-5-billion-years-189937*

Looking up at the moon in the night sky, you would never imagine that it is slowly moving away from Earth. But we know otherwise. In 1969, NASA's Apollo missions installed reflective panels on the moon. These have shown that the moon is currently moving 3.8 cm away from the Earth every year.

If we take the moon's current rate of recession and project it back in time, we end up with a collision between the Earth and moon around 1.5 billion years ago. However, the moon was formed around 4.5 billion years ago, meaning that the current recession rate is a poor guide for the past.

Along with our fellow researchers from Utrecht University and the University of Geneva, we have been using a combination of techniques to try and gain information on our solar system's distant past.

We recently discovered the perfect place to uncover the long-term history of our receding moon. And it's not from studying the moon itself, but from reading signals in ancient layers of rock on Earth

Reading between the layers

In the beautiful Karijini National Park in western Australia, some gorges cut through 2.5-billion-year-old, rhythmically layered sediments. These sediments are banded iron formations, comprising distinctive layers of iron and silica-rich minerals once widely deposited on the ocean floor and now found on the oldest parts of the Earth's crust.

Cliff exposures at Joffre Falls show how layers of reddish-brown iron formation just under a metre thick are alternated, at regular intervals, by darker, thinner horizons.

The darker intervals are composed of a softer type of rock which is more susceptible to erosion. A closer look at the outcrops reveals the presence of an additionally regular, smaller-scale variation. Rock surfaces, which have been polished by seasonal river water running through the gorge, uncover a pattern of alternating white, reddish and blueish-grey layers.

In 1972, Australian geologist A.F. Trendall raised the question about the origin of the different scales of cyclical, recurrent patterns visible in these ancient rock layers. He suggested that the patterns might be related to past variations in climate induced by the so-called "Milankovitch cycles."

Cyclical climate changes

The Milankovitch cycles describe how small, periodic changes in the shape of the Earth's orbit and the orientation of its axis influence the distribution of sunlight received by Earth over spans of years.

Right now, the dominant Milankovitch cycles change every 400,000 years, 100,000 years, 41,000 years, and 21,000 years. These variations exert a strong control on our climate over long time periods.

Key examples of the influence of Milankovitch climate forcing in the past are the occurrence of extreme cold or warm periods, as well as wetter or dryer regional climate conditions.

These climate changes have significantly altered the conditions at Earth's surface, such as the size of lakes. They are the explanation for the periodic greening of the Saharan desert and low levels of oxygen in the deep ocean. Milankovitch cycles have also influenced the migration and evolution of flora and fauna including our own species

And the signatures of these changes can be read through cyclical changes in sedimentary rocks.

Recorded wobbles

The distance between the Earth and the moon is directly related to the frequency of one of the Milankovitch cycles — the climatic precession cycle. This cycle arises from the precessional motion (wobble) or changing orientation of the Earth's spin axis over time. This cycle currently has a duration of ~21,000 years, but this period would have been shorter in the past when the moon was closer to Earth.

This means that if we can first find Milankovitch cycles in old sediments and then find a signal of the Earth's wobble and establish its period, we can estimate the distance between the Earth and the moon at the time the sediments were deposited.

Our previous research showed that Milankovitch cycles may be preserved in an ancient, banded iron formation in South Africa, thus supporting Trendall's theory.

The banded iron formations in Australia were probably deposited in the same ocean as the South African rocks, around 2.5 billion years ago. However, the cyclic variations in the Australian rocks are better exposed, allowing us to study the variations at much higher resolution.

Our analysis of the Australian banded iron formation showed that the rocks contained multiple scales of cyclical variations which approximately repeat at 10 and 85 cm intervals. On combining these thicknesses with the rate at which the sediments were deposited, we found that these cyclical variations occurred approximately every 11,000 years and 100,000 years.

Therefore, our analysis suggested that the 11,000-cycle observed in the rocks is likely related to the climatic precession cycle, having a much shorter period than the current ~21,000 years. We then used this precession signal to calculate the distance between the Earth and the moon 2.46 billion years ago

We found that the moon was around 60,000 kilometres closer to the Earth then (that distance is about 1.5 times the circumference of Earth). This would make the length of a day much shorter than it is now, at roughly 17 hours rather than the current 24 hours.

Understanding solar system dynamics

Research in astronomy has provided models for the formation of our solar system, and observations of current conditions.

Our study and some research by others represents one of the only methods to obtain real data on the evolution of our solar system, and will be crucial for future models of the Earth-moon system.

It's quite amazing that past solar system dynamics can be determined from small variations in ancient sedimentary rocks. However, one important data point doesn't give us a full understanding of the evolution of the Earth-moon system.

We now need other reliable data and new modelling approaches to trace the evolution of the moon through time. And our research team has already begun the hunt for the next suite of rocks that can help us uncover more clues about the history of the solar system.

Up Next:

NEXT MEETING: 8pm Friday 11th November - Nonsuch High School

Dr Steve Fossey from UCL will give us a talk on 'Extrasolar Planets'.

Ron Canham will also give a presentation on the sky at night for the coming month.

ANNUAL GENERAL MEETING: 8pm Friday 9th December – Nonsuch High School

NEXT USER GROUP:

Suspended until further notice.

NEXT DENBIES OBSERVING SESSION:

The next session, allowing for moon rise & set times and cloud conditions, may be sometime around the new moon on 23rd November. The precise date and timings of any session will be advised by email and WhatsApp a few days in advance

AD HOC OBSERVING AT WARREN FARM:

These will be at short notice when the weather is favourable. Please watch our WhatsApp feed for alerts.