JANUS
THE NEWSLETTER OF EWELL ASTRONOMICAL SOCIETY

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Editorial

Welcome to the April edition of Janus. Our speaker this month is John Axtell. At the time of writing, the subject of his lecture is not known - whatever it is, I'm sure it will be of great interest to members. Again, it will be a "hybrid" one with the option to attend either in person or via Zoom.

April is slightly unusual in that there are 2 new moons - the second, on 30th April, is known as a Black Moon. For those who may be curious, there is no single accepted definition of this term. It is commonly used to refer to one of the following phenomena:

- Second New Moon in the same month - occurs about once every 29 months
- Third New Moon in a season with 4 New Moons - occurs about once every 33 months
- No New Moon in February - occurs about once every 19 years
- No Full Moon in February - also occurs about once every 19 years

The re-launched group observing sessions at Ranmore are proving popular, and other group sessions are being considered at Warren Farm. Sadly, resumption of User Groups at Nonsuch is proving difficult.

Work to complete calibration and final commissioning of JWST continues to go well in preparation for the commencement of routine science operations in July. The most recent highlight has been the detection of a single star at a record-breaking distance of 12.9 billion light years. The star has been nicknamed "Earendel". More details can be found at *https://www.bbc.co.uk/news/science-environment-60931100.* For all the latest information on JWST go NASA's JWST site: *https://www.jwst.nasa.gov/*

John

The Solar System April

MERCURY: begins the month not readily observable since it is very close to the Sun, at a separation of only 2° from it. Observability improves as the month progresses and by the end of the month it is visible as an evening object, having recently passed greatest elongation E. Becoming visible around 21:01 BST, 11° above the W horizon, as dusk fades to darkness, it will then sink towards the horizon, setting 2 hours and 10 minutes after the Sun at 22:29.

VENUS: is visible as a morning object throughout the month, having recently passed greatest elongation W. It begins the month visible in the dawn sky, rising at 05:12 BST - 1 hour and 25 minutes before the Sun - and reaches an altitude of 8° above the SE horizon before fading from view as dawn breaks around 06:16. By the end of the month, despite rising at 04:27, it will be difficult to observe, reaching its highest point in the sky during daytime and being no higher than 5° above the horizon at dawn.

MARS: is currently emerging from behind the Sun and, throughout the month, is difficult to see. It will reach its highest point in the sky during daytime and be no higher than 4° or 5° above the horizon at dawn.

JUPITER: recently passed behind the Sun at solar conjunction. Throughout the month, it will be difficult to see as it will reach its highest point in the sky during daytime and be between 0° and 5° above the horizon at dawn.

SATURN: recently passed behind the Sun at solar conjunction. It begins the month difficult to see, reaching its highest point in the sky during daytime and being only 4° above the horizon at dawn. By the end of the month, it remains difficult to see, still reaching its highest point in the sky during daytime, although it will be 9° above the horizon at dawn.

URANUS: will soon pass behind the Sun at solar conjunction. At the beginning of the month, is very difficult to see, reaching its highest point in the sky during daytime and being no higher than 13° above the horizon at dusk. By the end of the month, it is extremely difficult to see since it is very close to the Sun, at a separation of only 4° from it.

NEPTUNE: recently passed behind the Sun at solar conjunction and begins the month extremely difficult to see as it is very close to the Sun, at a separation of only 17° from it. By the end of the month, it remains very difficult to see, reaching its highest point in the sky during daytime and being 4° below the horizon at dawn.

MOON PHASES:

New Moon	1 Apr
First Quarter	9 Apr
Full Moon	16 Apr
Last Quarter	23 Apr
New Moon	30 Apr

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*

April

1 M104 is well placed
3 Lunar occultation of Uranus
4 Conjunction of Saturn and Mars
M94 is well placed
5 Close approach of Saturn and Mars
6 C/2021 F1 (Lemmon-PANSTARRS) at perihelion
14 M51 is well placed
17 M3 is well placed
19 136108 Haumea at opposition
22 Lyrid meteor shower 2022
23 M101 is well placed
24 Conjunction of the Moon and Saturn
25 Close approach of the Moon and Saturn
Mercury at dichotomy
Conjunction of the Moon and Mars
26 Close approach of the Moon and Mars
27 Conjunction of the Moon and Venus
Close approach of the Moon and Venus
Conjunction of the Moon and Jupiter
Close approach of the Moon and Jupiter
28 Mercury at highest altitude in evening sky
29 Mercury at greatest elongation east
Asteroid 10 Hygiea at opposition
Conjunction of Venus and Jupiter
30 Close approach of Venus and Jupiter

Collected Observations (and thoughts) – Gary Walker

50 years since the launch of Pioneer 10 - 15 Mar

On 3rd March1972, Pioneer 10 - the first space probe to be launched out of the Solar System - embarked on its endless journey. It was the first probe to cross the Asteroid Belt and, even more to the point, it was the first probe to undertake a fly-by of an outer planet - Jupiter. It took nearly 2 years to get there, finally arriving on 3rd December 1973. The probe showed Jupiter up close although, by today's standards, the images were rather crude.

A year later, on 5th April 1973, Pioneer 11 was launched, and bypassed Jupiter on 4th December 1974. I remember being pleasantly surprised by hearing about this secpnd probe, as I hadn't realised that they had sent a second probe, until it reached Jupiter in December 1974. Pioneer 11 also flew past Saturn in September 1979. It crossed the orbits of Uranus in 1976, and Neptune in 1983 although, unfortunately, these two planets were not in the right place to be encountered by it.

At present, Pioneer 10, is just over 130 AU from the Earth (1 AU is the distance between the Sun and the Earth, so it is over 130 X 93 million (12.1 billion) miles, away). That also amounts to about 18 hours, 6 minutes, 22 seconds (18.6 light hours) from Earth. It is "in" the constellation of Taurus, heading in the direction of Aldeberan, but even at its high speed, it won't reach this area for about 2 million years! The last data from Pioneer 10 was received in 2002, and the last communication with it was in January 2003, before it finally gave up the ghost having been active for over 30 years!

Since, the Pioneers were Launched, the two Voyager probes were launched in August - September 1977 and, surprisingly enough, the first probe, Pioneer 10, is NOT the most

distant object, but Voyager 1 is, instead, at 155.8 AU. This is because it is moving faster. However, even at their fastest, neither would not reach a star at the distance of Alpha Centauri for at least 80,000 years!

All such probes used the gravitational “sling-shot” method to increase their speed, on bypassing the outer planets. The situation was helped by the fact that the outer planets formed a rare alignment, making it easier for the probes to reach them.

Now, with all these probes, and the New Horizon one that flew past Pluto in 2015, this means that all the planets of the solar system have now been flown past - or even orbited, and landed on (i.e. Venus and Mars).

Numerous missions have now been undertaken to Jupiter and Saturn, although Uranus and Neptune have only been visited once - long ago, by Voyager 1! Jupiter is still being orbited by the Juno probe.

It is worth remembering that despite them now being well beyond all the planets of the solar system, there is still the Kuiper Belt to cross and, beyond that, the Oort Cloud, which is way out at least 2000 AU and probably stretches out from the Sun for about 2 light years!

Voyager 1 would not even reach the inner edge of the Oort Cloud for about 300 years, and would then take 30,000 years to cross it! This is, however, academic as it's instruments would have failed, long before it even reached the Oort Cloud!

It is worth noting that, until 50 years ago, only the Moon, Venus and Mars had been explored, close-up. We were lucky that the first outer solar system probes were launched, as the original "Grand Tour" was cancelled by President Nixon in 1972, and I can remember how disappointed I was to hear that. Fortunately, however, we did get our "Grand Tour", after all. Apollo 16, launched in April 1972, was the penultimate Apollo Moon Mission.

I always think that the space probes have been the most useful and exciting forms of space exploration over the past 50 - 60 years, or so. Much has been discovered, including many things not even conceived of, 50 years ago. The outer planets and their moons have proved to be far more exciting and dynamic, rather than being just frozen objects where nothing ever happens.

From the perspective of Pioneer 10, now, the Sun will still be the brightest object in the sky at a magnitude of -16.3. For comparison, the Sun, as seen from Earth is of magnitude - 27, whilst the Full Moon is magnitude -12.5. The Sun, from Pioneer 10, is still 30X brighter than the Full Moon is from Earth!

As stated earlier, all the Pioneer, Voyager and New Horizon probes are now well beyond the planets, and have also crossed the Heliopause, during the current century, in about 2013, which means that they have reached interstellar space. However, surprisingly, the gravitational influence of the Sun reaches out for at least 2 light years, which is about half the distance to Proxima and Alpha Centauri, although at this distance it would be very weak! Thus, none of these probes will be able to reach beyond the solar system, entirely, for many thousands of years, despite their speeds of about 30,000 mph!

It is staggering that their distances from us can still only be measured in light hours, whereas any star is at least 4.4 light years, away. In that sense, the probes are only crawling their way along, and it just shows the immensity of space, even in the "local neighbourhood" of our Sun!

Communications with all these deep-space probes is, to say the least, challenging. Voyager 1 is furthest out at 155.8 AU, and light takes a staggering 21 hours, 33 minutes, and 55 seconds to reach it, from Earth. Voyager 2 is 129 AU away, with a light distance of 18 hours, 1 minute, and 40 seconds, from Earth. Pioneer 11 is 107 AU away, with a light time of 14 hours, 54 m, and 54 seconds. Finally, New Horizon is currently 52.9 AU out, with a light time of 7 hours, 20 minutes, and 41 seconds. Obviously, any messages to-and-fro, are now very slow!

The Orange Sky - 18 Mar

On 16th March, a weather system brought sand from the Sahara Desert as far North as the UK. It was particularly orange over Spain where it caused some breathing difficulties.

In Banstead, the overcast sky only appeared slightly orange, - just a tinge - or a dirty brownish colour, at most! It disappeared later in the afternoon, presumably because the rain brought the sand out of the atmosphere! There was no Sun visible at all.

It rained in the afternoon and, especially on the next day, I saw spatters of orange sand on my dustbins, and on cars in the High Street - the cars had spots and streaks of sand on their bonnets and roofs! The next day papers showed orange skies even over London, but it did not appear anything as vivid, in Banstead!

Some will remember the Red Sun of 16th October 2017, where the Sun turned orange-to-red in the early afternoon and, later, the sky turned a weird yellow, then a dirty white-brownish colour, reminiscent of a sepia photograph! This was again down to Saharan sand, along with smoke from forest fires in Spain and Portugal, being wafted this way!

This phenomenon occasionally occurs in this country, with sand being deposited upon cars, as it was in 1987, for example. All-in-all, over the past 2 years, it certainly seems as if we have been experiencing the 10 Biblical Plagues of Moses!

The orange colour seen on 16th March was due to the phenomenon of Rayleigh Scattering, where sunlight shining through the dust particles means that the red end of the spectrum is emphasised, similar to that seen at sunrise and sunset. On the day, there were a few posts on Facebook, and other local social media about the Orange Sky.

I collected some of the sand, off the tops of my waste bins, and examined it with my stereo microscope, which has magnifications from 10X to 45X. Even with that, I could not really see the individual sand grains, so they were obviously very fine - I just saw then forming clumps of sand. They were obviously very lightweight, too! The sand had collected everywhere - in corners, cracks, crevices, and on surfaces such as the lids of my bins. On cars, it formed spots and streaks, being as car surfaces are totally smooth!

The Dearth of Planets - 19 Mar

In February and March, planets have been thin on the ground (or rather in the sky!) in the evenings, with only Uranus being present. This is because all the other planets are at present, stuck in the morning sky. Venus has been there, for a while, even beforehand, but has been poorly placed and hard to see!

Mars is very low in the early morning sky, and very small, as it commences its long and slow climb back up to its next opposition in December. Jupiter and Saturn have also just passed around the sun, and Neptune was in solar Conjunction, on 15th March too! Thus, it is strange to have virtually no evening planets on view, at present!

On the plus side, the Sun has now been active for some months, with plenty of sunspots on most days - some of them quite large.

The Hampshire Astronomical Group - 25 Mar

People may remember that some of us visited the Clanfield Observatory in Hampshire in September 2017, home of the Hampshire Astronomical Group. Well, they have just published a book, "A short history of the Hampshire Astronomical Group 1960-2020".

This book is lavishly illustrated and describes the construction and types of the various telescopes on site, and the several moves they have had to make. They moved to their present site at Clanfield in 1972, so they have been there for about 50 years. Their society is a bit older than ours by 6 years!

The book costs £6,plus £1.70 p&p, and can be ordered from Graham Bryant at *president@hantsastro.org.uk*, or by Janet Turner at *secretary@hantsastro.org.uk*

Just like our own Society, the Pandemic has caused havoc to the group over the past 2 years and the site had to be shut for much of 2020.

The end of Comet Atlas! - 26 Mar

I have been observing and (of course) reporting on Comet Atlas since late November 2021, so I have been observing it for about 4 months. I could still see it up until 23rd March, but it seems to have drastically faded between then and about 24th March. At that point, it had still not moved far from Castor and Pollux, in Gemini.

A face on the Sun! - 28 Mar

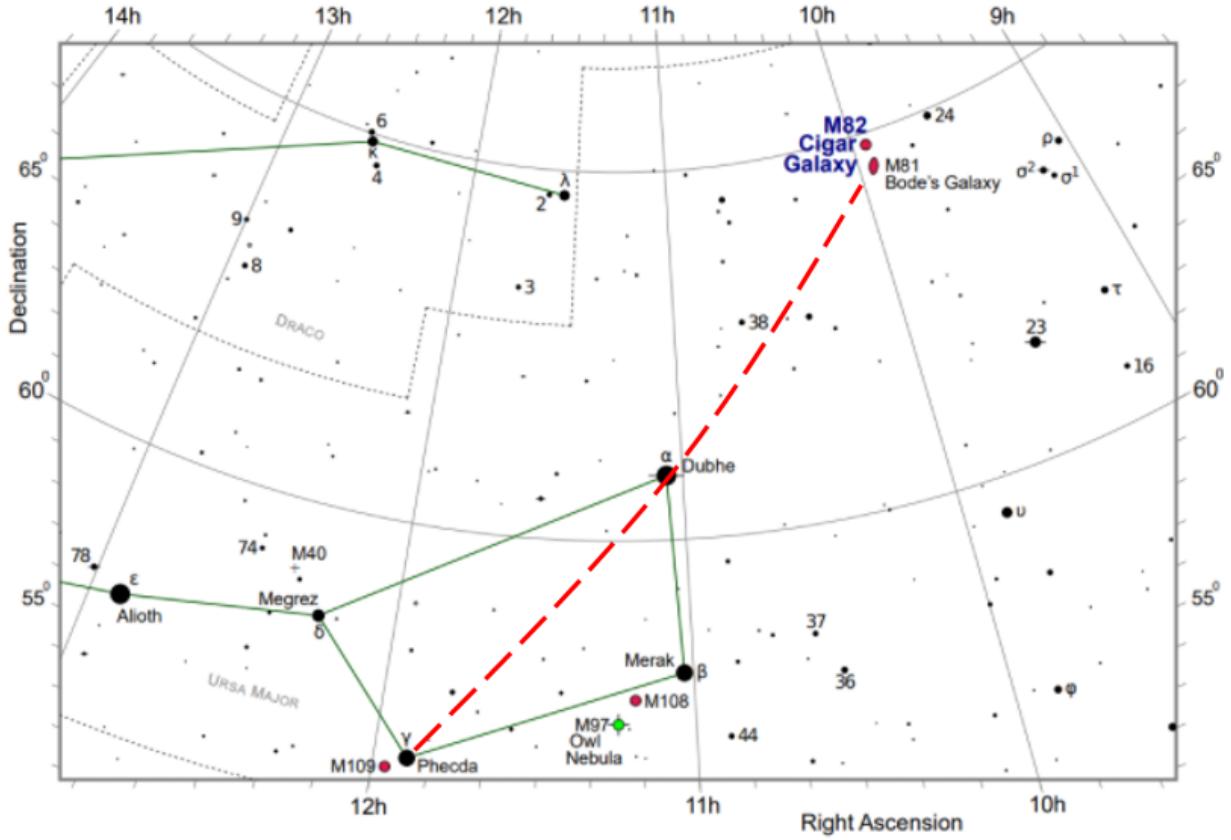
The Sun is certainly "busy" nowadays and, on 27th - 28th March, there were at least 5 separate spot groups on the Sun. There has been a large spot with multiple umbrae and penumbra.

Also present is a Face on the Sun, which is a spot with multiple umbrae and penumbra, too.
It has 2 small umbrae near its top, resembling 2 eyes and a long linear umbra, near the bottom, representing a mouth. Also, off to the West of this major spot group, is a whole V-shaped formation of at least 16 small spots. Is something, or somebody, trying to send a message to Earth?

Objects of the month – M81 and M82 - Martin Howe

Over the last three months we have looked at objects within our own Milky Way galaxy, but this month we travel a little further afield to take in the galaxies M81 and M82. These are otherwise known, respectively, as Bode's galaxy (after its discover, Johann Bode in 1774) and the cigar galaxy, and lie in the constellation of Ursa Major. Subject to your local horizon, these are visible all year round (known as circumpolar objects, as they never set) but at this time of year are approaching their highest positions in the sky.

Although faint (magnitudes 6.9 and 8.4 respectively, and so not visible to the naked eye) and quite small (27'x 14' and 11' x 4'), they should be visible with 10x50 binoculars or a small telescope, subject to sky conditions. The two galaxies are quite easy to locate by tracing a line from γ Ursae Majoris (Phecda) through α Ursae Majoris (Dubhe) and continuing for a similar distance.



The two galaxies are only about half a degree (a full Moon's diameter) apart, and this is not just a line-of-sight alignment – the two galaxies are only about 150,000 light years apart and are gravitationally interacting with each other. This is a similar separation as the Large Magellanic Cloud is from our galaxy, so the view in the night sky from a planet in M82 must be absolutely spectacular, given that M81 is about half the size of the Milky Way!

Both galaxies have hosted supernovae in relatively recent times. SN 1993J in M81 was detected in 1993 and, at the time, was the second brightest supernova observed in the 20th century. SN 2014J was discovered in M82 in 2014 and was a chance discovery by a group of students undertaking instruction at UCL's observatory at Mill Hill in north London. It was discovered during a 10 minute demonstration on how to use the CCD camera on one of the Celestron C14s at the observatory!

The first image below is of M81 and M82, and was taken from an inner London suburb in February 2022 with a ZWO ASI294MC Pro camera attached to a 127mm refractor. It is comprised of 60 sub-exposures totalling just over 120 minutes.

The second image, showing M82 with the supernova SN 2014J, was taken in 2014 (also from London) with a 102mm refractor and an ATIK 314L mono CCD with RBG filters for a total exposure of 80 minutes.

A solar power station in space? Here's how it would work – and the benefits it could bring

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The UK government is reportedly considering a £16 billion proposal to build a solar power station in space.

Yes, you read that right. Space-based solar power is one of the technologies to feature in the government's Net Zero Innovation Portfolio. It has been identified as a potential solution, alongside others, to enable the UK to achieve net zero by 2050.

But how would a solar power station in space work? What are the advantages and drawbacks to this technology?

Space-based solar power involves collecting solar energy in space and transferring it to Earth. While the idea itself is not new, recent technological advances have made this prospect more achievable.

The space-based solar power system involves a solar power satellite – an enormous spacecraft equipped with solar panels. These panels generate electricity, which is then wirelessly transmitted

to Earth through high-frequency radio waves. A ground antenna, called a rectenna, is used to convert the radio waves into electricity, which is then delivered to the power grid.

A space-based solar power station in orbit is illuminated by the Sun 24 hours a day and could therefore generate electricity continuously. This represents an advantage over terrestrial solar power systems (systems on Earth), which can produce electricity only during the day and depend on the weather.

With global energy demand projected to increase by nearly 50%by 2050, space-based solar power could be key to helping meet the growing demand on the world's energy sector and tackling global temperature rise.

Some challenges

A space-based solar power station is based on a modular design, where a large number of solar modules are assembled by robots in orbit. Transporting all these elements into space is difficult, costly, and will take a toll on the environment.

The weight of solar panels was identified as an early challenge. But this has been addressed through the development of ultra-light solar cells (a solar panel comprises smaller solar cells).

Space-based solar power is deemed to be technically feasible primarily because of advances in key technologies, including lightweight solar cells, wireless power transmission and space robotics. Importantly, assembling even just one space-based solar power station will require many space shuttle launches. Although space-based solar power is designed to reduce carbon emissions in the long run, there are significant emissions associated with space launches, as well as costs.

Space shuttles are not currently reusable, though companies like Space X are working on changing this. Being able to reuse launch systems would significantly reduce the overall cost of space-based solar power.

If we manage to successfully build a space-based solar power station, its operation faces several practical challenges, too. Solar panels could be damaged by space debris. Further, panels in space are not shielded by Earth's atmosphere. Being exposed to more intense solar radiation means they will degrade faster than those on Earth, which will reduce the power they are able to generate.

The efficiency of wireless power transmission is another issue. Transmitting energy across large distances – in this case from a solar satellite in space to the ground – is difficult. Based on the current technology, only a small fraction of collected solar energy would reach the Earth.

Pilot projects are already underway

The Space Solar Power Project in the US is developing high-efficiency solar cells as well as a conversion and transmission system optimised for use in space. The US Naval Research Laboratory tested a solar module and power conversion system in space in 2020. Meanwhile, China has announced progress on their Bishan space solar energy station, with the aim to have a functioning system by 2035.

In the UK, a £17 billion space-based solar power development is deemed to be a viable concept based on the recent Frazer-Nash Consultancy report. The project is expected to start with small trials, leading to an operational solar power station in 2040.

The solar power satellite would be 1.7km in diameter, weighing around 2,000 tonnes. The terrestrial antenna takes up a lot of space – roughly 6.7km by 13km. Given the use of land across the UK, it's more likely to be placed offshore.

This satellite would deliver 2GW of power to the UK. While this is a substantial amount of power, it is a small contribution to the UK's generation capacity, which is around 76GW.

With extremely high initial costs and slow return on investment, the project would need substantial governmental resources as well as investments from private companies.

But as technology advances, the cost of space launch and manufacturing will steadily decrease. And the scale of the project will allow for mass manufacturing, which should drive the cost down somewhat.

Whether space-based solar power can help us meet net zero by 2050 remains to be seen. Other technologies, like diverse and flexible energy storage, hydrogen and growth in renewable energy systems are better understood and can be more readily applied.

Despite the challenges, space-based solar power is a precursor for exciting research and development opportunities. In the future, the technology is likely to play an important role in the global energy supply.

Up Next:

NEXT MEETING: 8pm Friday 8 April 2022 - Nonsuch High School

John Axtell will talk about a subject yet to be confirmed. Attendance via Zoom will also be possible for those members preferring not to attend in person.

Ron Canham will also deliver his Sky at Night presentation for the month to come.

NEXT USER GROUP:

Suspended until further notice.

NEXT DENBIES OBSERVING SESSION:

The next session, allowing for moon rise & set times and cloud conditions, will be sometime around the new moon on 30th April. The precise date will be advised by email and WhatsApp a few days in advance

Meet at The Stepping Stones pub in West Humble about 6:30pm and go up to Ranmore around 7pm

AD HOC OBSERVING AT WARREN FARM:

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