JANUS

THE NEWSLETTER OF EWELL ASTRONOMICAL SOCIETY

October 2024 EDITION

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Editorial

Welcome to the October edition of Janus. Our lecture this month, entitled “Herschel’s Planet”, will be given by Michael Foulks, Director of the BAA Saturn, Uranus and Neptune section.

No one will need reminding that the weather during September was generally poor. Sadly, this meant the cancellation of the annual picnic and, with it, the loss of an opportunity for members to gather for a convivial evening of discussion, followed by some observing; perhaps we’ll fare better next year! In the meantime, with the Autumn equinox now behind us and the end of BST on 27 October, there is the prospect of some longer, less anti-social hours, observing evenings, before Winter sets in – provided, of course, the weather improves. 🤞🤞

Last month, I highlighted continuing concerns about the adverse effects on astronomy of Starlink and other constellations of satellites in low earth orbit. Until now, these concerns have centered on the chains of bright objects and streaks visible in optical images. Now, however, there is increasing concern that RF signals emitted by the satellites as part of normal operations can interfere with radio astronomy sensors (links to more information later in this edition of Janus).

Although it’s still only October, members are advised that nominations for committee membership are required in time for voting at the AGM in December. Currently, there are 8 committee members (Chair, Secretary, Treasurer, Janus Editor, 4 others). If you wish to nominate someone, please complete a copy of the nomination form attached to this edition of Janus.

John

SkyUpdate
What’s up this month?

The Solar System October

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

VENUS: begins the month having recently passed behind the Sun at superior solar conjunction. Slightly difficult to see, it will reach its highest point in the sky during daytime and be no higher than 3° above the horizon at dusk. By the end of the month, emerging into the evening sky as it approaches greatest elongation E, it remains difficult to see as it will reach its highest point in the sky during daytime and be no higher than 6° above the horizon at dusk.

MARS: is currently visible as a morning object. It begins the month visible in the dawn sky, rising at 23:07 BST and reaching an altitude of 59° above the SE horizon before fading from view as dawn breaks at around 06:19. By the end of the month, still visible in the morning sky, it becomes accessible around 22:37, when it reaches an altitude of 10° above the NE horizon. It will then reach its highest point in the sky at 05:22, 60° above the S horizon, and will be lost to dawn twilight around 06:13, 58° above the SW horizon.

JUPITER: is currently emerging from behind the Sun. Visible in the morning sky, it becomes accessible around 22:35, when it reaches an altitude of 7° above the NE horizon. Reaching its highest point in the sky at 05:39, 61° above the S horizon, it will be lost to dawn twilight around 06:38, 58° above the SW horizon. By the end of the month, visible in the morning sky, it becomes accessible around 19:35, when it reaches an altitude of 7° above the NE horizon. Reaching its highest point in the sky at 02:38, 61°

above the S horizon, it will be lost to dawn twilight around 06:28, 37° above the W horizon.

SATURN: recently passed opposition, and begins the month becoming accessible at around 19:19, when it rises to an altitude of 11° above the SE horizon. Reaching its highest point in the sky at 23:20, 30° above the S horizon, it will become inaccessible at around 03:22 when it sinks below 11° above the SW horizon. By the end of the month, as an early evening object, it is visible in the evening sky, becoming accessible around 17:18, 18° above the SE horizon, as dusk fades to darkness. Reaching its highest point in the sky at 20:17, 29° above the S horizon, it will continue to be observable until around 00:14, when it sinks below 11° above the SW horizon.

URANUS: Begins the month visible in the morning sky, becoming accessible around 22:38, when it reaches an altitude of 21° above the E horizon. It will then reach its highest point in the sky at 03:56, 57° above the S horizon, before being lost to dawn twilight around 05:40, 51° above the SW horizon. By the end of the month, now approaching opposition, it is visible from around 19:37, when it reaches an altitude of 21° above the E horizon. Reaching its highest point in the sky at 00:54, 57° above the S horizon, it will be lost to dawn twilight around 05:29, 27° above the W horizon.

NEPTUNE: recently passed opposition and begins the month visible from around 20:55, when it rises to an altitude of 21° above the SE horizon. Reaching its highest point in the sky at 00:14, 36° above the S horizon, it will become inaccessible at around 03:33 when it sinks below 21° above the SW horizon. By the end of the month, visible in the evening sky, it becomes accessible around 17:56, 22° above the SE horizon, as dusk fades to darkness. It will then reach its highest point in the sky at 21:09, 36° above the S horizon, and will continue to be observable until around 00:27, when it sinks below 21° above the SW horizon.

MOON PHASES:

New Moon	2 October
First Quarter	10 October
Full Moon	17 October
Last Quarter	24 October
New Moon	1 November

Notable Events:

Some observations will require a telescope, others will be visible with the naked eye. More information at *https://in-the-sky.org*

October

1 The Andromeda Galaxy is well placed

2 Annular solar eclipse
The Moon at apogee

3 136472 Makemake at solar conjunction
NGC 253 is well placed

4 Small Magellanic Cloud is well placed
NGC 300 is well placed

5 October Camelopardalid meteor shower 2024
Close approach of the Moon and Venus
The Moon at perihelion

6 NGC 362 is well placed

7 Lunar occultation of Antares

8 Draconid meteor shower 2024

9 Jupiter enters retrograde motion

10 Southern Taurid meteor shower 2024

11 δ-Aurigid meteor shower 2024

12 Comet C/2023 A3 (Tsuchinshan-ATLAS) passes perigee

14 Close approach of the Moon and Saturn
Lunar occultation of Saturn
The Triangulum Galaxy is well placed

15 The Moon at aphelion
Lunar occultation of Neptune

17 The Moon at perigee
Asteroid 19 Fortuna at opposition

18 136199 Eris at opposition
ε-Geminid meteor shower 2024

19 Close approach of the Moon and M45

21 Orionid meteor shower 2024
Close approach of the Moon and Jupiter
Lunar occultation of Beta Tauri

23 Mercury at aphelion
Close approach of the Moon and Mars

24 Leonis Minorid meteor shower 2024
136108 Haumea at solar conjunction

26 The Perseus Double Cluster is well placed

27 Asteroid 1036 Ganymed at opposition
British Summer Time ends

29 The Moon at apogee

30 Venus at aphelion

November

3 Conjunction of the Moon and Mercury
The Moon at perihelion

4 Lunar occultation of Antares
Close approach of the Moon and Venus

11 Close approach of the Moon and Saturn
Lunar occultation of Saturn

12 Lunar occultation of Neptune
Northern Taurid meteor shower 2024

13 Asteroid 11 Parthenope at opposition

14 The Moon at aphelion
The Moon at perigee

15 Saturn ends retrograde motion

16 Close approach of the Moon and M45
Mercury at greatest elongation east

17 Uranus at opposition
Leonid meteor shower 2024
Close approach of the Moon and Jupiter
Lunar occultation of Beta Tauri
The Pleiades cluster is well placed

20 Close approach of the Moon and Mars

21 Mercury at dichotomy
α-Monocerotid meteor shower 2024

22 Mercury at highest altitude in evening sky

26 The Moon at apogee

27 Lunar occultation of Spica
The Hyades cluster is well placed

28 November Orionid meteor shower 2024
Comet 333P/LINEAR passes perihelion

Collected Observations (and thoughts) – Gary Walker

Murphy's Law Rules in Astronomical Observing – Posted 1 Sep

It can truly be said that Murphy's Law rules astronomical observing. Murphy's Law, (also known as Sod's Law) says that if something CAN go wrong, it WILL go wrong - and at the worst possible time! Sir Patrick Moore referred to it as Spode's Law.

In an early version of his Sky at Night, he was trying to film night sky objects with his telescope for TV. Every time he tried, it kept clouding over, only for the sky to clear entirely once the programme had finished, by which time it was too late!

The most obvious manifestation of Murphy's Law is the law that the more interesting a certain astronomical event will be, the greater the chance it will be clouded out. We are all too familiar with this scenario, especially in the case of eclipses!

The 11 August 1999 Total Solar Eclipse should have been visible over Cornwall and Devon, but was mostly clouded out, except for a few lucky areas, where the clouds parted, enabling some to witness Totality. Elsewhere in Britain, away from the total eclipse zone, the weather was often much clearer, and the big partial eclipse was well seen, for example, in the Society's local area!

In the case of the 20 March 2015 big eclipse, which reached 86% in our area, that too was clouded out by an annoying bank of cloud across Eastern England that rocked up two

nights earlier, then persisted throughout the entire eclipse! To add insult to injury, the sky cleared after the eclipse had finished. Even, where it was visible, the weather was often awkward to the last, and impossible to forecast. The event was best seen to the North of London and across Western England, although it seemed to be only visible in lucky spots across the UK, and other areas often suffered from clouds!

When observing the Sun, Murphy's Law will inevitably ensure the following:

- Any cloud, whether big or small, will inevitably make a bee line for the Sun.
- Any clear sky break will invariably miss the Sun - or else it will only skim the edge of it, thereby negating its usefulness.
- Cumulus clouds often have an annoying habit of forming "Cloud Streets", whereupon one cloud follows another, in the same path across the sky. Also, they can be elongated in the direction of the wind, meaning that they take even longer to pass across the Sun.
- When waiting for a clear sky break to reach you, in slow moving high cloud, a lower, faster moving cloud, can

overtake the clear break, and obscure it, entirely.
- Some slow-moving cirrocumulus clouds even expand whilst passing across the Sun, ensuring they take even longer to clear away.
- If clouds, and corresponding clear breaks are slow moving, it can be difficult to judge exactly where they are going, with the result that you can find that a clear sky break that you have been eagerly waiting for, will completely miss the Sun. Only the cloud WILL reach the Sun.
- When having to observe low altitude events, the sky will inevitably be cloudy, low down near the horizon, whilst it is clear, or nearly so, higher up. This can, however, be down to an effort of Parallax, where clouds near the horizon appear to bunch up, but if you were actually in that area, you would see that the clouds were in fact much more widely spaced out.

Murphy's Law will also ensure that the nights before and after the closest point of a Planetary Conjunction will be clear, but the night that the planets are closest, will inevitably be overcast. The same law applies to eclipses.

In the case of observing Mars, when it is at its closest oppositions, for those of us in the Northern Hemisphere, Murphy's Law will ensure that Mars will be situated at a very low altitude in the Southern sky, making it vulnerable to atmospheric blurring. Furthermore, just to add to the fun, when Mars is at a close opposition, it can be prone to a planetary-wide dust storm, which can blot out the surface features. When, however, Mars is at distant oppositions, it will be high up in our skies!

Yet another example of this Law, is that any bright comets are often at their best only in the Southern Hemisphere, just when they are invisible to us! Even Halley's Comet was at its best in the Southern Hemisphere, although that was not a particular good apparition of this comet, anyway.

Even planets like Mercury and Venus are higher up in the Southern Hemisphere, than they are, here.

Finally, some deep sky objects such as Omega Centauri, 47 Tucanae (two of the best Globular Clusters in the entire sky), the Southern Cross, with the "Jewel Box", the Magellanic Clouds, and the Centre of our Galaxy, (where the Milky Way is brightest,) are forever invisible to the Northern Hemisphere.

However, despite Murphy's Law ruling astronomical observations, we sometimes DO manage to see what we want to see, which is really rewarding and fantastic when it happens!

What Sir Patrick Moore always advised for beginners – Posted 6 Sep

Sir Patrick Moore always had a set number of essential steps for the beginner in Astronomy to take:

- Read some books on Astronomy. After all, it would be essential to know the basics about the sky.
- Learn your way around the constellations and obtain a star chart.
- Try to recognise a few constellations and, in the case of the Great Bear (Ursa Major), use the end stars of Merak and Dubhe as "Pointers", to point your way to others such as the Pole Star in the Little Bear (Ursa Minor), and on to Bootes, etc.
- Resolve to identify one new constellation each night - only then, consider buying an optical aid.
- Buy Binoculars first, so as to see objects better – in his opinion, these are far better than the "junkscopes" available. With binoculars, you can observe star clusters, coloured stars, nebulae, and the Moon. Also, the star fields of the Milky Way.
- Join your local astronomical society!

Patrick then offered advice on buying a Telescope. He strongly stated that the smallest telescope that was useful for astronomical observation was either a 3" refractor, or a 4" reflector, with a 6" reflector being considerably better. He was certainly scathing about the 60mm, or smaller, refractors that were so often seen in department stores such as Dixons, or in camera shops.

This is because such small telescopes are not much better than toys, often having poor

optics, with lenses often being made of plastic. Invariably, they are advertised with highly inflated claims about how much they magnify (a sure sign of a "junkscope"). In recent years, however, some better-quality telescopes have appeared of about 80-90mm aperture, which are good enough for proper observations.

Another thing that he suggested was to make your own telescope and grind your own mirror. This used to be a popular, cheap way of obtaining a telescope, but is not so common nowadays. Patrick also said that you could buy a second-hand telescope, but only if you first checked that it was good enough to use!

He was especially against the "Sun Filters" that screwed into the eyepiece end of the "junkscopes", as there was a serious danger that the build-up of heat concentrated on it, could result in it splintering, thus blinding the observer! His advice for these filters was to hire a boat, take it out about 3 miles into the sea, and drop the filter in the sea!

when I first became interested in Astronomy in about 1970, telescopes were really expensive. Patrick said that a 3" refractor would cost about £40, whilst a 6" reflector would cost about £50. Prices like that were, indeed, Astronomical, for me and my parents, so there was no chance of obtaining one of these. In later years, their prices rocketed up even more. In more recent years, however, prices have come down, presumably due to the ability of container ships to deliver them. Even the Personal Solar Telescope came down to a manageable £400, although it will have gone up again now.

My first ever telescope was a 40X 40mm one, given to me at Christmas 1970. I used to lust after the telescopes at Dixons and, in the end, in 1975, my parents bought me one from Dixons, in Sutton, half price at about £29. This was the classic 60mm refractor, with 3 eyepieces, giving magnifications of 28X, 56X, and 177X. Whilst this would classify as a "junkscope", it was the only way that I could obtain a telescope in those days. In any case, it was only this and similar ones that were easy to find, as real astronomical telescopes were hard to find (no Internet, of course, in those far off days!), and even harder to afford!

However, I could, and still can, see quite a lot of astronomical objects with it, such as the Moon, Sun, and Planets such as Venus, Mars, Jupiter, Saturn, and even, on occasion, Mercury! It can also show open star clusters, Globular Clusters and some nebulae, as well as double stars. Of course, it had its limitations, but I could still see quite a bit, with it, and the highest magnification of 177X was not excessive.
In those days, I still believed that high magnifications were essential for some observations. In the final analysis, this is true, especially for observing details on planets, where you need magnifications of at least 100X - 300X. Low magnifications are of limited use, in this situation. However, the telescope must be able to support the magnification being used, and even really large telescopes don't usually go above 300X - 400X, often much less, if the atmospheric conditions are poor. Amateur astronomers often state that the maximum "usable" magnification for any telescope is about twice that of its aperture, so, a good 60mm refractor reaches its limit at 120X, whilst a 200mm scope should not go above 400X, and then ONLY in exceptionally good and steady conditions!

That is why the often stated "600X Power" that is frequently used to advertise telescopes of only 60mm aperture, is totally misleading. Such a high-power CAN, theoretically be used with such a scope, but the resulting image would only come out blurred and dim. Sadly, it is not surprising that newcomers can be fooled by these claims, as people tend to expect that they will get a stupendous view at 600X.

Only, many years later, did I finally have the means to buy my 8" SCT, and a Ha Solar telescope.

Despite the passage of years, the advice given by Sir Patrick Moore still holds up well. He also said that any telescope must have a good, solid mount. He especially hated the Pillar and Claw mount, which he remarked was as stable as a jellyfish.

Lastly, he said that a telescope needed good quality eyepieces, and he always said that having a good telescope with a poor-quality eyepiece, was as bad as playing a record with a poor stylus. Again, referring to

binoculars and telescopes, he always said that a good pair of binoculars was far better than a cheap telescope (i.e. a "junkscope"). Whilst always firmly stating his views, he was, of course, well aware of the fact that even the smaller, good astronomical telescopes were very expensive!

Lost in Space! – Posted 12 Sep

If you have found yourself being delayed, e.g., on holiday or business flights, then spare a thought for the two astronauts, Suni Williams and Butch Wilmore, who launched on Boeing's new Starliner shuttle to the International Space Station. They were only meant to be in space for 8 days, but problems occurred with the Starliner craft, meaning that they reached the Space Station, but could not leave, as the Starliner was deemed unsafe!

In the end, the Starliner had to be sent back, on its own, without its passengers, and the astronauts were told that they would have to wait until February, for a SpaceX Dragon craft to pick them up. The Spaceliner DID, however, land, safely.

This reminds me of the Cosmonaut, Sergei Konstantinovich Krikalev, who because of the collapse of the Soviet Union, ended up, also Lost in Space, for a total of 311 days, on the Mir Space Station, which was twice as long as his mission was supposed to be.

He was already on the Mir Space Station, when the Soviet Union collapsed, in late December 1991, and he suddenly didn't have a homeland to return to! Nobody would take responsibility for his return until, finally, a joint Soviet-German mission managed to return him to earth on 25 March 1992! He COULD, incidentally, have left Mir, by a single space capsule, but refused, as he felt that if he did, the Mir Station mission would come to an end, too!

Space IS THE news today – Posted 12 Sep

We amateur astronomers are all too familiar with the lack of Space, or Astronomy related news in the Media. Indeed, in the BBC, it usually comes up, as the "and finally" item on the main news.

Today, however, Space was, for once, THE Top Story on the. 6pm, BBC news! This was because the first ever privately funded spacewalk was carried out by a billionaire, Jared Isaacman, and Sarah Gillis from a SpaceX Dragon craft. It was called the Polaris Dawn Mission.

The spacewalk was carried out at an altitude of 435 miles, but the spaceship had also climbed to an altitude of 870 miles, which is the furthest distance from Earth for a human spaceflight craft since the Apollo Missions.

Venus – Posted 13 Sep

Today, I managed to see Venus through my telescope, for the first time since last year. It only appeared fairly small, even at 222X, but then it was nearly at its furthest from Earth, so only subtended an angular size of 11' arcseconds.

Venus appeared as a "Full" phase, although it was actually 90% phase, making the gibbous phase very hard to see. Of course, at this point in its present apparition, it is at its least interesting.

Believe it, or not, Venus is currently in the evening sky, but it has been too close to the Sun, setting soon afterwards, thereby rendering it effectively invisible. Today's observation of Venus was in the afternoon, around 3pm!

Small Partial Lunar Eclipse – Posted 18 Sep

I have just finished observing the small Partial Lunar Eclipse as, no doubt, you all were, as well! The times of the eclipse were as follows:

- Start of Penumbral eclipse 01:47 BST
- Start of Umbral eclipse 03:12 BST
- Maximum eclipse 03:44 BST
- End of Umbral eclipse 04:15 BST
- End of Penumbral eclipse 05.47 BST

I didn't really bother with the Penumbral phase, as such. However, the Penumbral shadow was already visible, by 02:58, even with the naked eye.

I saw the Umbral shadow from about 03:20 onwards. Even with the naked eye, the Moon appeared "misshapen" on one side, with a small bite taken out of it.

Maximum eclipse was at 03:24. However, being as this was only a very small, shallow, Partial Lunar Eclipse, even at maximum eclipse, it only covered about 8% of the Moon.

The shadow appeared dark, with no colour, because the shadow was so small. In my 8" SCT, the limb of the Moon within the shadow was still visible, albeit only dimly! The shadowed limb was not visible through my 11 X 80 binoculars, though.

This shadow was upon the top limb of the Moon. It appeared as a shallow curving area of darkness. It gradually shrunk back and left the Moon, although, as always, the Penumbral shadow persisted for a bit longer, and even at 04:20, it was still visible even with the naked eye. It had, however, gone by about 04:33, although it still showed up in photographs that I took at this time!

Weather wise, there were some "nuisance clouds" scudding across the sky from NE to SE, during at least the first half of this eclipse. Luckily, they were only thin cumulus or stratocumulus cloud, in which the Moon was nearly always visible. Later, the clouds disappeared completely, at least for a time! An added bonus was that it was a very warm night, and dead calm!

This eclipse was about the same magnitude as the one last year, on 28 October. I also saw other small Partial Lunar Eclipses on 7 September 2006, and 25 April 2013.

Incidentally, this was the 30th lunar eclipse that I have seen in 49 years of observations since 1975! In this country, it is always so rewarding when one manages to successfully observe a rare astronomical event, with our weather being the way it is!

The BBC News mentioned this eclipse in the weather forecast, but probably not so much for the eclipse itself, but rather because it occurred on the night of a so-called "SuperMoon"!

Media response on the Lunar Eclipse – Posted 19 Sep

The 1pm, news mentioned this eclipse, inevitably at the end of it, and showed a couple of pictures of it, but it literally only lasted a few seconds - very much, "Blink and you'll miss it" affair. However, the end of the 6pm News had a longer report, albeit more to do with the “SuperMoon", rather than the actual eclipse. The eclipse, itself, was too small to be of interest to the Media, so it was really the "coincidence" of an eclipse at the time of the "SuperMoon" that was newsworthy. Given that Lunar Eclipses ALWAYS occur on a Full Moon, it is, of course, inevitable that sooner or later, one will coincide with a" SuperMoon"!

On the Thursday, following the event, only a few newspapers covered it, with photographs of the "SuperMoon", but only mentioning the eclipse, in passing. There were no photographs of the eclipse, itself.

Incidentally, the media has been much more aware about the possibility of more Aurora displays, including one, a few days ago, that failed to materialise. Obviously, they were covering the one back on 10 May.

Latest Observations – Posted 28 Sep

Last night, I saw a total of 5 planets - Jupiter, Saturn, Mars, Uranus and Neptune. Jupiter is now well separated from Mars, and rising earlier, after their conjunction last month!

Mars was still small, even at 300X, but then, it was still only 7.3' angular size, and I couldn't see any features on it. I saw Uranus, which, as usual, appeared very small, even at 300X - but it did display a beautiful delicate blue/turquoise colour to it. Neptune was close to the South of a star, but I wasn't sure of seeing any colour to it.

Going to deep sky objects, I saw that the variable star, Mira, was a bit brighter than a close neighbouring star - a non-variable star of magnitude 9, that I use as a handy comparison star. Thus, Mira must be starting to brighten, although it is still near its minimum, being as it is still about magnitude 8 or 9.

I looked at M76, a planetary nebula, known as the "Little Dumbbell Nebula", as it has a similar 2 lobes and hourglass shape, just like M27, the "Dumbbell Nebula"! I could see M76, as a distinctly egg-shaped object, fairly bright, and I could also see the hourglass shape!
The galaxy, NGC 1023, was visible as a small fuzzy patch, relatively bright, very close

to two stars in the telescope. Despite being small, this galaxy appeared egg shaped, or elongated in shape.

The night was totally cloudless, dead calm, but a bit damp, especially as it had rained for much of this day.

Astronomers can't agree on how fast the universe is expanding. New approaches are aiming to break the impasse

Acknowledgement: This article was written by Alex Hall, Royal Society University Research Fellow, School of Physics and Astronomy, The University of Edinburgh, and was first published in THE CONVERSATION on 19th September 2024. It is republished in full under a Creative Commons Licence. The original article, with additional links and images can be found here: *https://theconversation.com/astronomers-cant-agree-on-how-fast-the-universe-is-expanding-new-approaches-are-aiming-to-break-the-impasse-236985*

It is almost 100 years since scientists discovered the universe is expanding. In the decades that followed, the accuracy of the measurements, and interpretations and implications of this discovery, were a source of fierce debate. We now know the universe emerged dramatically from a highly compressed state in an event known as the Big Bang.

Measurements of the present-day expansion rate, known as the Hubble constant or H_0 (pronounced H-naught), have improved considerably since those early days. However, a new debate now grips the astronomy community: two independent measurements of H_0, which should agree, give different results. This situation has become known as the "H_0 tension", or Hubble tension.

Numerous conferences, review articles and journal papers have been dedicated to this issue. Some refer to it as a "crisis" for cosmology", requiring a paradigm shift in our understanding of the universe. The expansion of the universe is a key aspect of its history since the Big Bang, so it underpins many other elements of our understanding.

Others view the H_0 tension simply as a sign that the measurement teams do not fully understand their data and that, with better data, the "crisis" will be resolved. But its solution remains elusive.

The two measurement methods at the centre of this debate are the "distance ladder" and the "cosmic microwave background". The distance ladder is the older of the two, and has been used in various forms since the earliest detection of the universe's expansion.

The first evidence came from pioneering measurements of faint cloud-like objects that we now know to be galaxies outside the Milky Way. American astronomer V.M. Slipher measured the chemical signatures in the light from these objects. Using the technique of spectroscopy to match these signatures with those of known molecules, he found their wavelengths were stretched compared with standard laboratory results.

This stretching of the wavelengths of light from other galaxies, known as "redshift", is caused by the Doppler effect. This phenomenon is also responsible for the pitch of a wailing siren increasing as an emergency vehicle approaches, then decreasing as it passes. In a seminal 1917 article, Slipher announced that almost all the galaxies he'd observed were receding from the Milky Way.

Slipher's data would go on to be used by Edwin Hubble in his famous 1929 study showing that the more distant a galaxy is, the faster it recedes and hence the greater its redshift. The ratio between redshift and distance is the Hubble constant.

Expansion of the universe had already been anticipated by theorists. In the early 1920s, Alexander Friedmann and Georges Lemaître independently realised that Albert Einstein's recently published theory of general relativity could predict an expanding universe, and that the implications of this would be galaxy redshifts that increase with distance.

Distance ladder

Distant galaxies are being dragged away from us because of the universe's expansion. Measurements of the Hubble constant rely on determining the connection between the distance of these objects and the speed at which they are receding.

For this reason, the units of H_0 are conventionally "kilometres per second per megaparsec", referring to the speed of an object one megaparsec away (a unit of distance used by astronomers, equivalent to about 3 million light years).

Just as Slipher did a century ago, recession speeds can be readily measured using spectroscopy. However, accurate distance measurements to galaxies are notoriously difficult, so this is where the distance ladder comes in.

The lowest "rung" of the ladder represents objects in the sky that are close enough that we can use direct methods to measure distance – such as the parallax method, where the motion of the Earth around the Sun creates periodic shifts in the angular position of the objects. The subsequent rungs represent measurements of progressively more distant sets of objects.

These are chosen to be objects for which it is easy to measure relative distances but, like a ruler with no numbers on it, their absolute distance must be calibrated. This function is provided by objects on the lowest rung.

Cepheids – bright and massive stars that pulsate – are particularly useful as rungs due to the tight correlation between their pulsation period and brightness, discovered by Henrietta Swan Leavitt in 1908. The most distant rung is usually formed by Type 1a supernovae (explosions that occur when certain stars reach the ends of their lives), which have also provided definitive evidence that the universe's rate of expansion is increasing.

Cosmic microwaves

The other measurement method at the centre of the debate is the cosmic microwave background (CMB). This is light emitted when the universe was just a few hundred thousand years old – long before stars or planets had formed. Instead, a hot plasma filled all of space, almost perfectly uniform except for sound waves thought to have their origin at the Big Bang.

The physics of the universe at this time is surprisingly simple, so we can make robust predictions about the properties of these waves. When combined with precision measurements, our mathematical models tell us what the expansion rate of the universe was at this early time. With a model for the subsequent expansion history, we can make an extremely precise prediction of H_0.

Now, let's look at what each method finds for H_0. The most precise distance ladder measurement comes from the SH0ES scientific team led by Nobel laureate Adam Riess. Their latest measurement gives H_0 = 73.2km per second per megaparsec. The most precise CMB measurement, from the European Space Agency's Planck satellite team, is H_0 = 67.4km per second per megaparsec.

Even though these two measurements are within 10% of each other, the difference is huge compared with the percent-level precision of each measurement. It's also above the "5 sigma" statistical threshold conventionally taken by scientists as indicative of an event that is not purely due to random chance.

So, what could be causing this large discrepancy between the two measurements? One culprit could be that the model used to predict H_0 from the CMB is wrong. Perhaps an alternative model for the universe would reconcile the CMB prediction with the distance ladder measurement. There has been intense activity amongst theorists along these lines over the past few years.

The main obstacle is that the evolution of the universe is strongly constrained by a range of robust measurements accumulated over decades. Furthermore, the CMB measurement of H_0 is corroborated by independent measurements of comparable precision using surveys of galaxies. The latest such measurement from the Dark Energy Spectroscopic Instrument (Desi) collaboration gives H_0 = 68.5km per second per megaparsec, with roughly 1% precision –- in agreement with the CMB value.

Getting creative

Theorists have therefore had to get creative. One suggestion is that the very early universe went through a sudden phase of enhanced expansion prior to the CMB being emitted. This made the first atoms form sooner than standard expectations. The idea is that the "standard" CMB measurement of H_0 neglected this effect and inferred that the Hubble constant was smaller than it really is.

The challenge for solutions of this sort is that they must also predict the other detailed patterns seen in the CMB, which have been measured with exquisite precision by the Planck satellite and other telescopes.

Other proposed solutions include suggestions of magnetic fields affecting the formation of the first atoms, or even that Earth resides in an atypical part of the universe that has expanded to an unusually large extent. Disappointingly, none of the proposed solutions is both compelling and able to fit all the available data.

An alternative, if more prosaic, line of reasoning is that our physical picture of the universe is correct, but that one or more of the measurements has neglected some observational effect. This has fuelled intense interrogation of the SH0ES and Planck measurements, both by the astronomy community and the teams themselves. So far, no errors have been discovered in either analysis.

The road ahead

So, what is the way forward? Some highly promising techniques using alternative rungs in the distance ladder have recently emerged as competitive to the SH0ES measurement.

A team led by Wendy Freedman, an American pioneer of modern H_0 studies, has used particular stars that fall into a category known as the "tip of the red giant branch" (TRGB) to make new calibrations of supernovae distances. This method can avoid uncertainties inherent in the use of Cepheids. Intriguingly, it gives H_0 = 69.8 - a constant in between Planck and SH0ES, albeit with larger uncertainties.

Furthermore, Freedman's team recently found a discrepancy between galaxy distances implied by TRGB stars and Cepheids using the James Webb Space Telescope (JWST). If corroborated by future analyses, this discrepancy would place the distance ladder approach on a much more uncertain footing.

The quality of H_0 measurements will inevitably improve with new data from JWST, new samples of supernovae, and innovative techniques such as using gravitational waves from merging black holes. But whether these efforts will resolve the Hubble tension, or worsen it, remains to be seen.

For now, our understanding of the universe continues to be dogged by disagreement in measurements of the expansion rate. One hundred years after its conception, the Hubble constant continues to confound us.

Object of the month – The October Super Hunter's Moon Rise
Martin Howe

This month's object is a regular favourite of mine – the Super Moon rise. The Moon's orbit around the Earth is not exactly circular, but slightly elliptical in shape. Strictly speaking, the Earth and the Moon both actually orbit around the common centre of gravity – the barycentre – but given the larger mass of the Earth, this point lies a little below the surface of the Earth. The Moon's average distance from the Earth is about 378,000 km, but due to the elliptical nature of the orbit, this distance can vary between 357,000 km and 407,000 km. This can make the Moon's apparent diameter appear about 10% larger at perigee (closest approach) compared to apogee (when the Moon is furthest from the Earth). When perigee coincides with the full Moon this can make for stunning photographs, even with the most basic of equipment, such as a good phone camera or DSLR with a long telephoto lens.

October's full Moon occurs on the 17 October, with a perigee of just over 357,000 km, so will be pretty much as close as it can get to the Earth in its orbit.

The key to taking dramatic Moonrise photographs is to capture the Moonrise soon after it clears the horizon. This is when it is best placed to reveal the "Moon illusion" – a well-known phenomenon that makes the Moon appear (to our brains) even larger than it really is. This illusion is further enhanced by ensuring that you have an attractive foreground in your photograph – this can be almost anything – a distant mountain peak, trees, or structures such as monuments or churches.

It is also important to do your research on the exact times of the Moonrise and the best location to ensure that the Moon rises behind your selected foreground target. There are many apps that will help you in your planning such as the Photographers' Ephemeris, Mooncalc.org, or Sky Safari. Also consider the time and azimuth of the moonrise on the day either side of the full Moon, as the azimuth of the moonrise and the foreground illumination from the recently set Sun will vary slightly each day (as will the weather conditions!). Also be aware that the Moon does rise surprisingly fast – about one full Moon's diameter in about 2 minutes – so be ready with your camera before the designated time. Bear in mind that if your local horizon is not perfectly flat then it may also take several minutes before the Moon pokes its head above any hills or buildings.

The image below was taken from Lisbon, with Castelo de São Jorge (St George's castle) in the foreground, using a Canon 80 DSLR and a 300mm telephoto lens. This was the September 2024 super ("Harvest") Moon rise, which was at a similar distance from Earth as the October super Moon will be.

Links to Articles on Starlink Inference with Radio Astronomy Observations

BBC News: Musk's satellites 'blocking' view of the universe
https://www.bbc.com/news/articles/cy4dnr8zemgo

BBC News: Concern over satellite impact on giant telescope
https://www.bbc.com/news/science-environment-54457344

Astronomy and Astrophysics: Bright unintended electromagnetic radiation from second-generation Starlink satellites
https://www.aanda.org/articles/aa/full_html/2024/09/aa51856-24/aa51856-24.html

Astro: Second-Generation Starlink Satellites Leak 30 Times More Radio Interference, Threatening Astronomical Observations
https://www.astron.nl/starlink-satellites/

Important Reminder:

To allow sufficient time to compile Janus and place it on the EAS Website by the 1st of the month any submissions for publication are required at least 3 days before the end of the month. Any items received after this date will be held over until the following month.

Up Next:

NEXT MEETING: 8pm Friday 11 October – Nonsuch High School

Michael Foulks Director of the BAA Saturn, Uranus and Neptune section will give a talk entitled "Herschel's Planet".

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

NEXT USER GROUP:

Suspended until further notice.

NEXT DENBIES OBSERVING SESSION:

The next session, allowing for moon rise & set times and cloud conditions, should be sometime around the new moon which is on 2 October.

The precise date and timings of any session will be advised by email and WhatsApp a few days in advance but should be within the period 30 September to 11 October.

AD HOC OBSERVING AT WARREN FARM:

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

Ewell Astronomical Society

We the undersigned wish to nominate

(Please Print Name of Nominee).....

as candidate for the Committee Ballot for 2024/ 2025

Proposer: (Signed)..... (Please Print Name).....

Seconder: (Signed)..... (Please Print Name).....

Signature of nominee to indicate willingness
to stand for election

.....

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