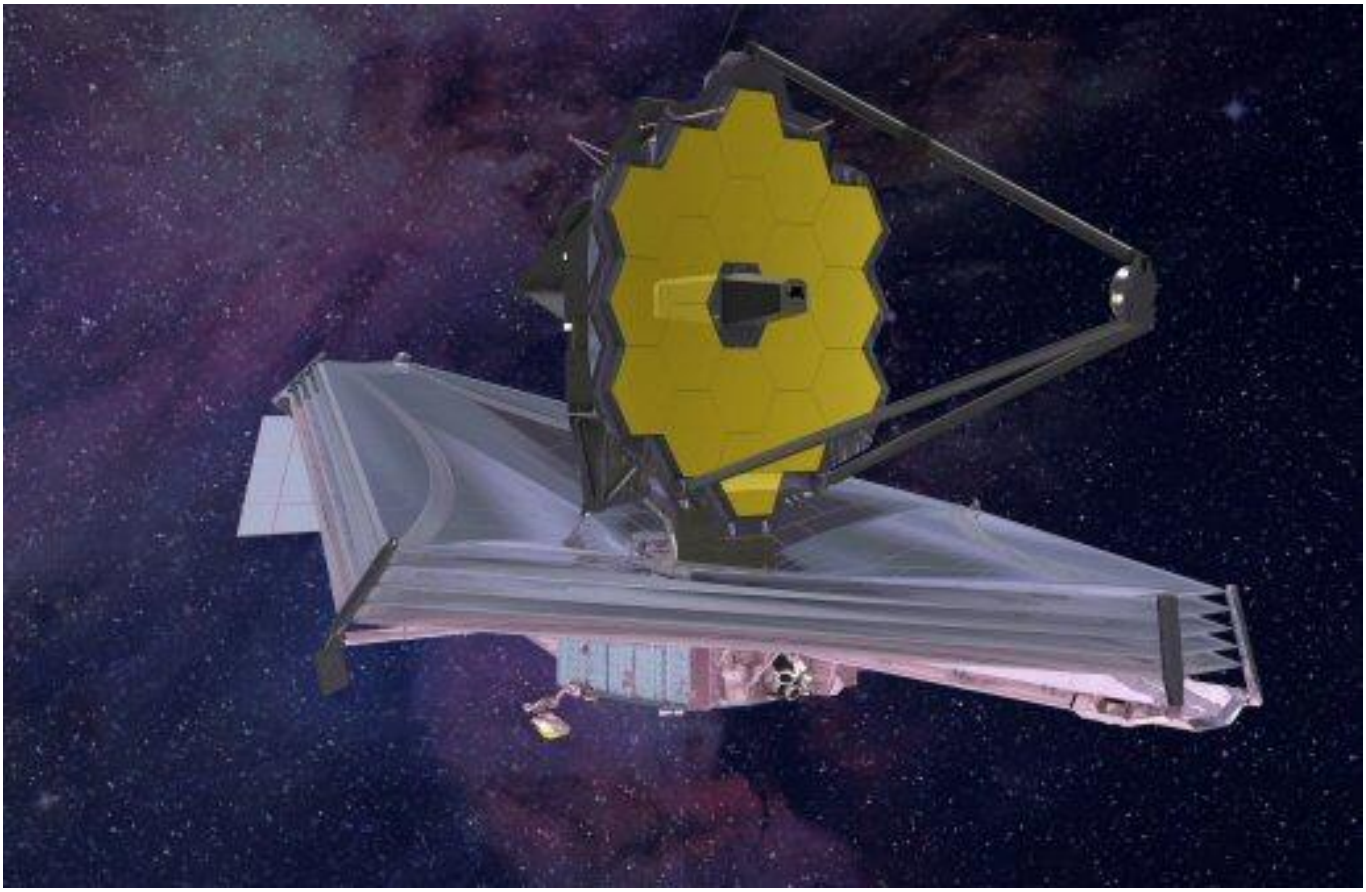
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – FEBRUARY 2022

JAMES WEBB SPACE TELESCOPE IS ON ITS WAY



An artist's impression of the James Webb Space Telescope (JWST)

NASA's James Webb Space Telescope or JWST was launched on an Arianespace's Ariane 5 rocket on Saturday 25th December 2021, from the ELA-3 Launch Zone of Europe's Spaceport at the Guiana Space Centre in Kourou, French Guiana. JWST is an infrared telescope with a 6.5 metre primary mirror. The observatory will study every phase of cosmic history from within our solar system to the most distant observable galaxies in the early universe.

The James Webb Telescope is NASA's largest and most powerful space science telescope ever constructed. Webb's enormous size and frigid operating temperature present extraordinary engineering challenges. After launching from French Guiana, the observatory will travel to an orbit about one million miles away from Earth and undergo six months of commissioning in space.

It started its mission by unfolding its mirrors and sunshield. It then initiated other smaller systems such as cooling system; aligning; and calibrating systems. Astronomers worldwide will soon be able to conduct scientific observations to broaden our understanding of the universe. Webb will also complement the science achieved by other NASA missions.

The James Webb Project is an international collaboration between NASA and its partners that include the ESA (European Space Agency) and the Canadian Space Agency. There have been thousands of engineers and hundreds of scientists working together to make Webb a reality, along with over 300 universities, organisations, and companies from 29 U.S. states and 14 other countries around the world.

Although Webb has successfully launched, its journey is only just beginning. It will embark on its month-long journey to its destination, a million miles from Earth. In the six months after launch the Webb space observatory commissioning will take place. The first astronomic results are expected to start in the summer of 2022.

The giant mirror for the telescope had to be launched with the 18 segments folded inside the launch vehicle so it had be unfolded during its journey and all the segments perfectly aligned, in space. A huge sunshield the size of a tennis court is needed to keep the instruments cold enough to work and this also had to be unfurled in space.

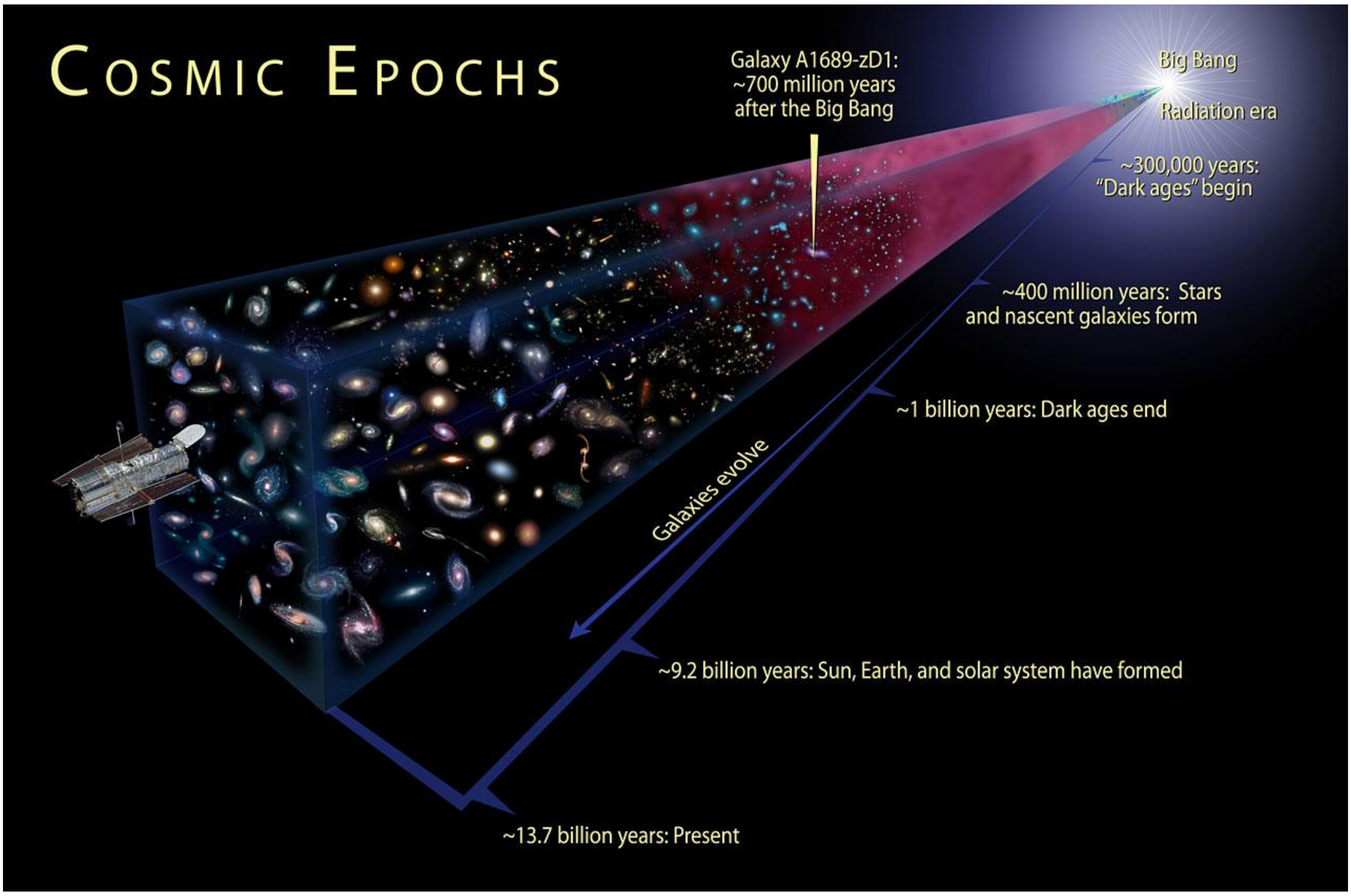
NEWBURY ASTRONOMICAL SOCIETY MEETING

4th February	A History of Women in Astronomy
Website:	**www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

16th February	The James Webb Space Telescope
Website:	**www.naasbeginners.co.uk**

THE MISSION OF THE JAMES WEBB TELESCOPE



Hubble looking back towards the Big Bang

The Hubble Space Telescope was able to look further out into deep space than any other telescope. It was able to see some of the first galaxies to form after the creation of the Universe in the event we call the Big Bang.

The event that we call the 'Big Bang' is thought to have occurred about 13.8 billion 'Earth' years ago. This is when time began for us and everything in our Universe was created. For us anything that happened or was there before the Big Bang has no meaning to us because we can never see out beyond our Universe, it is now too big and it is too far for us to see to outer the edges.

We cannot know what caused the Big Bang but we can speculate for ourselves as to what happened in the beginning. What we can say is there was an enormous release of energy and it occurred at a very small point.

We can also see that the Universe, as we see it today, is expanding. If we look at the light coming from the galaxies around us we can see, by examining the light, that they are all moving away from each other (with a few exceptions). So if we work out the directions that the galaxies are travelling and we project their path back, they all appear to have come from the same place.

This means that in the past the Universe was much smaller and everything was much closer together. If we continue this thought back far enough then the whole universe appears to have started out from the same place. The trajectories of everything show that it all would have been in the same place about 13.8 billion years ago. So the 'Big Bang' could have occurred at an infinitely small point known as a 'Singularity'.

We don't know what caused the Big Bang but we do know that when it formed it was very small, very dense and very hot. In fact it was so dense and hot that it could not exist as any form of matter that we can conceive of today so with think of it being a ball of pure energy. It was too hot and too dense for any kind of what we call matter (atoms) to exist.

In the first sub-second phase on the diagram above the pure energy expanded and cooled enabling sub-atomic particles (proto-matter) to form. It seems very strange that matter can be created from energy but Albert Einstein's famous equation $E = mc^2$ shows us it is possible. If we mathematically transpose ($E = mc^2$) into ($m = E \div c^2$) then we have Mass (matter) created from Energy (E) divided by the speed of light squared (c x c).

In the first 1000 years the sub-atomic particles were forced together by pressure and heat and started to create Protons [the positive (+) nucleus of an atom] and Electrons [the negative (-) particles orbiting a Proton]. As Protons and Electrons fused together they created atoms of Hydrogen gas. Some sub atomic particles called Neutrons (similar to Protons but with no electrical charge not + or -) but were able to be combined into the forming atoms to create stable isotopes of these atoms.

The Nuclear Fusion process also produced sub-atomic energy packets called photons that are the carrier of what would become light. However these photons could not leave the expanding fireball because it was too dense and opaque. After about 300,000 years most of the subatomic particles had been converted into atoms and the universe became transparent. The photons could be released as electromagnetic waves (light) and began their journey through the expanding Universe.

LOOKING BACK TO THE BEGINNING

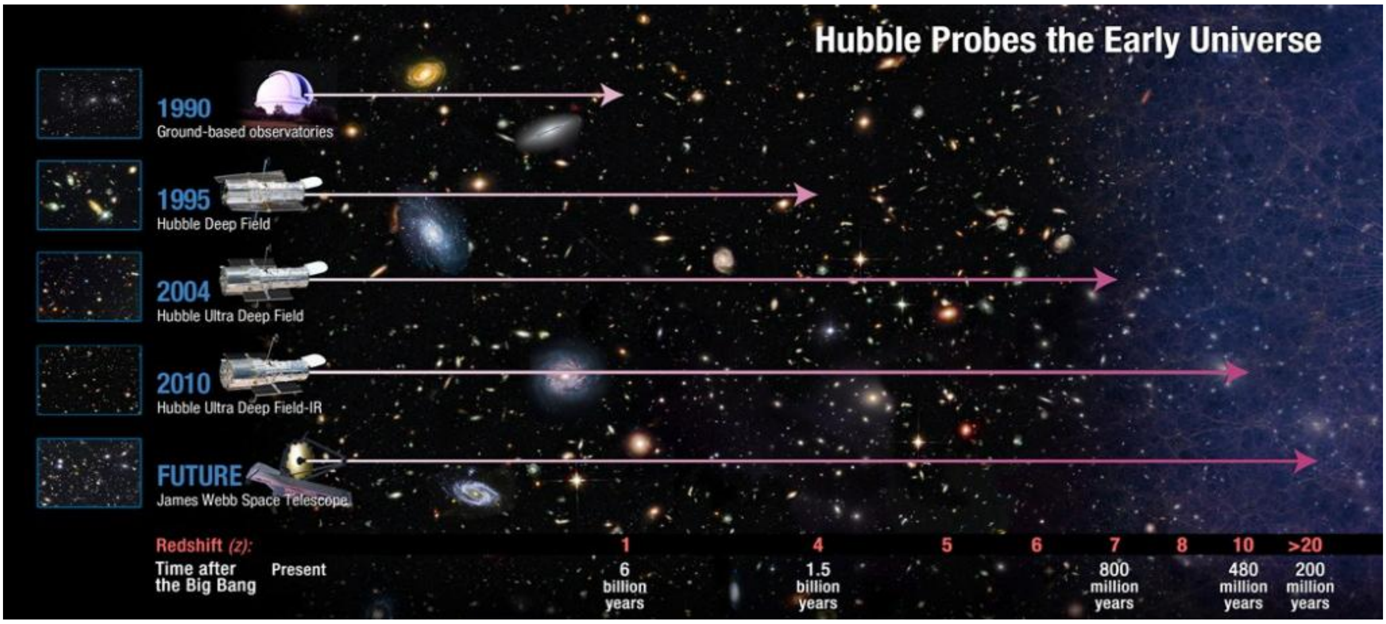
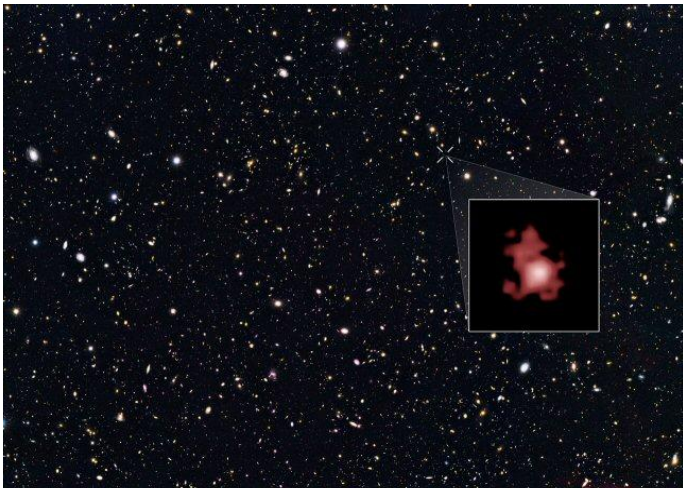


Diagram showing the developement of the Universe

We can see that the Universe, as we see it today, is expanding. If we look at the light coming from the galaxies around us we can see, by examining the light, that they are all moving away from each other (with a few exceptions). So if we work out the directions that the galaxies are travelling and we project their path back, they all appear to have come from the same place.

The diagram above shows how far telescopes could see into the distant Universe. With subsequent upgrades to the Hubble Space Telescope and its cameras we have been able to see further and further until we can start to see the most distant galaxies.



The most distant galaxy A1689-zD1 seen by Hubble

The image above was taken by the Hubble Space Telescope and is known as the Hubble Ultra Deep Image. It shows a galaxy (enlarged) that formed about 700 million years after the Big Bang. There are a number of things to consider from this image. The first consideration is: How can we see this galaxy now when it formed and emitted its light 13 billion years ago?

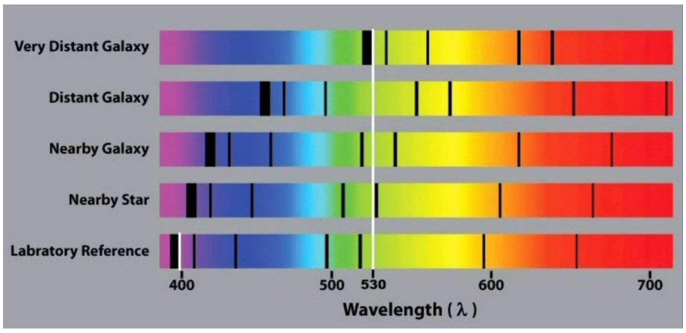
The simple answer is it has taken the light rays (photons) 13 billion years to reach us. So there is a deeper thought here – 'we are seeing the galaxy as it appeared 13 billion ago so we are looking back through time 13 billion years'.

This is a big thing to get our mind around. To simplify the situation think about our Sun that is 150 million kilometres away from us so its light (travelling at 300,000 km/sec) takes 8 minutes to reach us. We are looking at the Sun 8 minutes back in time. So the further away a star (or galaxy) is the further back we are looking at its past.

The second consideration is – Why does the galaxy (called A1689-zD1) look red in the image? We have previously seen that the Universe has been expanding since it was created in the Big Bang. To fully understand the expansion of the Universe we must take this concept one step further. What we need to appreciate is that the universe is not just expanding but the space that is encompassed by the Universe is also expanding.

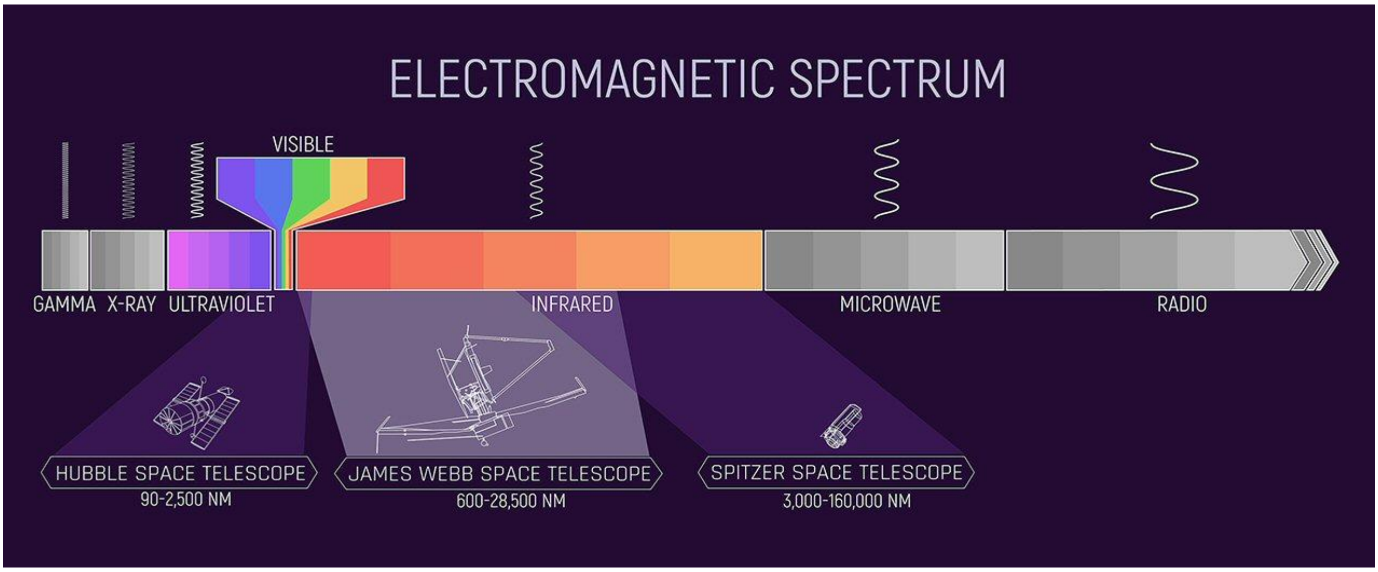
This expansion of space in the Universe has a profound effect on the electromagnetic waves (light) travelling through the space. As space is stretched by the expansion, the light waves are also stretched to make the waves longer. If we consider visible light the shortest waves are blue and the longest are red. The expansion of the Universe stretches the light waves so light that was initially blue can be stretched so that its wave length will be increased to make it appear red.

As light passes through gas and dust some wave lengths are absorbed and leave dark bands on the spectrum. The diagram below shows how the bands are shifted to the red end. The further away, the more the bands are shifted. The waves and information carried by the waves have been shifted to the red we call this **'Red Shift'**.



Patterns carried by light are shifted to the Red

WHAT IS THE JAMES WEBB TELESCOPE LOOKING FOR?



A diagram showing the light that HST and JWST can see

The diagram on the previous page shows how far ground based telescopes and the Hubble Space Telescope can see with each of its upgrades. On that diagram we can see that the HST was able to see galaxies that are located about 13.3 billion light years away. This means the light from those galaxies has been travelling through space for 13.3 billion years.

We have seen, on the previous page, that light waves travelling through the expanding Universe are stretched due to the space and the Universe expanding and stretching. This means the light from the most distant galaxies has been stretched out into the red and even the inferred wave lengths. Information imprinted on these stretched waves has also been moved into the red and even into the inferred wavelengths.

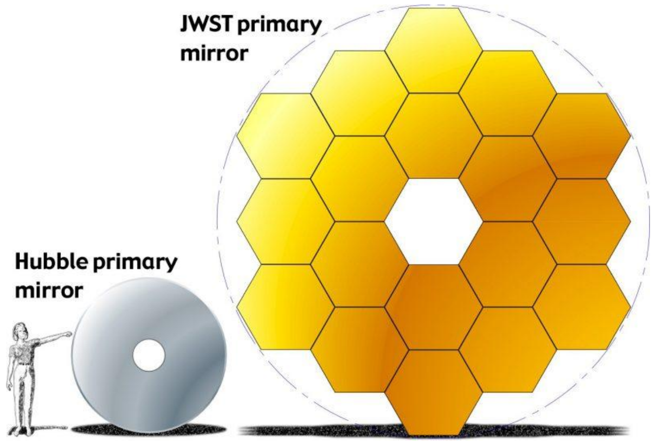
The diagram above shows the wavelengths of light that the HST and JWST can examine. The HST can detect visual light and some of the shorter (called 'near') inferred wavelengths but it cannot see into the longer (called 'far') inferred wavelengths. The JWST has been designed as a primarily inferred telescope so it can examine the longer far inferred wavelengths of light.

On the previous page we discussed the capabilities of the HST that has given us a major enhancement in our knowledge of the early Universe. However the 'Red Shift' effect on the light from the very first stars and galaxies has made this light beyond the detection capabilities of the HST. These critical light waves are now too long and into the far inferred so cannot be seen by the HST.

The JWST has been designed especially to be sensitive to these longer inferred wavelengths of light. The diagram above shows how the sensitivity of the HST encompasses the visible light range and just into the 'near' inferred. The range of the sensitivity of the JWST extends from visible red light through most of the longer wavelengths of inferred making it an Inferred Telescope. To enhance this capability the main mirror of the JWST is coated with pure Gold to improve its capability to reflect inferred light.

Hubble's main mirror has a diameter of 2.4 metres and the JWST's aperture is 6.5 metres across so this gives it almost ten times the light grasp of Hubble.

The diagram below shows the comparison of the HST and JWST main mirrors. The JWST mirror is made as eighteen hexagon shaped segments that were folded to fit into the Ariane 5 rocket that carried it into space.



Comparison of the HST and JWST main mirrors

The main improvements over the HST are the increased telescope aperture and the ability to detect inferred light. With a mirror almost three times wider, JWST will be able to see objects almost ten times fainter than HST allowing us to see objects ten times fainter. This in conjunction with the ability to detect light further into the inferred will enable scientists to peer even further back in time to see the very first stars and galaxies as they were 13.6 billion years ago or just 200 million years after the Big Bang.

One of the most noticeable features of the JWST is the enormous and complicated heat shield that will protect the telescope from unwanted heat. The detectors for observing in inferred must be kept very cold because these rays are what we recognise as radiated heat. To enable these rays to be studied any other sources of heat must be kept away from the telescope.

At the time of writing the JWST was on its way to the special location where it will observe the distant Universe. During its journey it will deploy and unfold the main mirror and the huge and essential heat shield. It will make adjustments to its trajectory and commission all its essential systems. On the next page we will take a look at where it will be going.

THE OBSERVING LOCATION FOR THE JWST

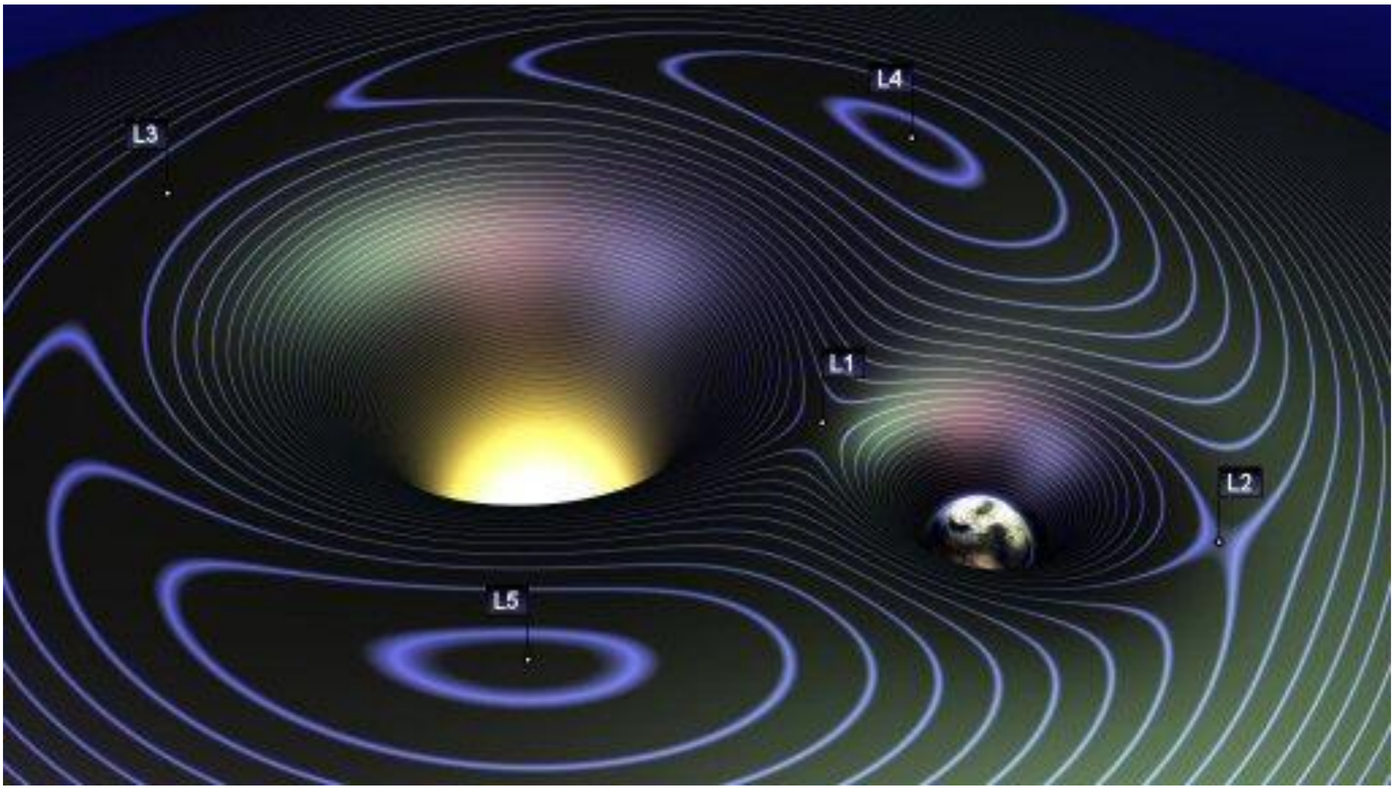
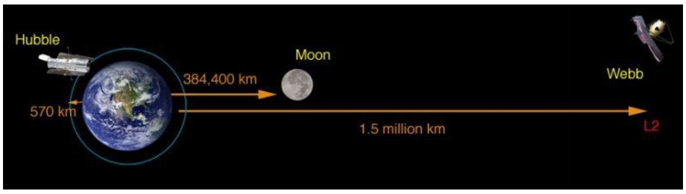


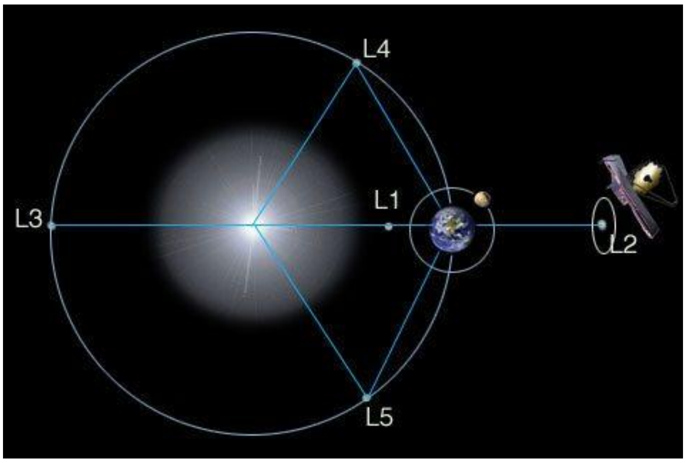
Diagram showing the Lagrange Points around the Sun

The JWST will be located near the second Lagrange point (L2) of the Earth-Sun system which is 1,500,000 km (930,000 miles) from Earth, directly opposite to the Sun. Normally an object circling the Sun further out than Earth would take longer than one year to complete its orbit but near the L2 point the combined gravitational pull of the Earth and the Sun allow a spacecraft to orbit the Sun in the same time it takes Earth to orbit the Sun.



The observing locations of HST and JWST

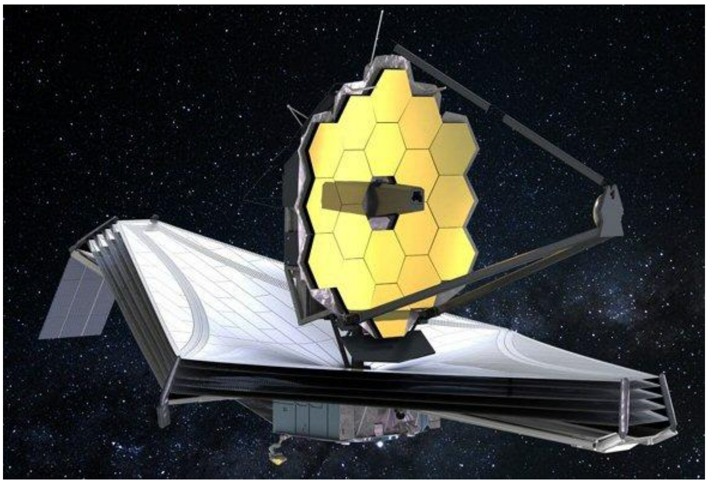
The telescope will circle around the L2 point in a halo orbit which will be inclined with respect to the ecliptic, have a radius of approximately 800,000 km (500,000 miles) and take about half a year to complete.



JWST will loop around the L2 point

As L2 is just an equilibrium point with no gravitational pull, a halo orbit is not an orbit in the usual sense. The spacecraft is actually in orbit around the Sun and the halo orbit can be thought of as controlled drifting to remain in the vicinity of the L2 point. This requires some station-keeping: around 2–4 m/s per year from the total budget of 150 m/s. Two sets of thrusters on the JWST constitute the observatory's manoeuvring system.

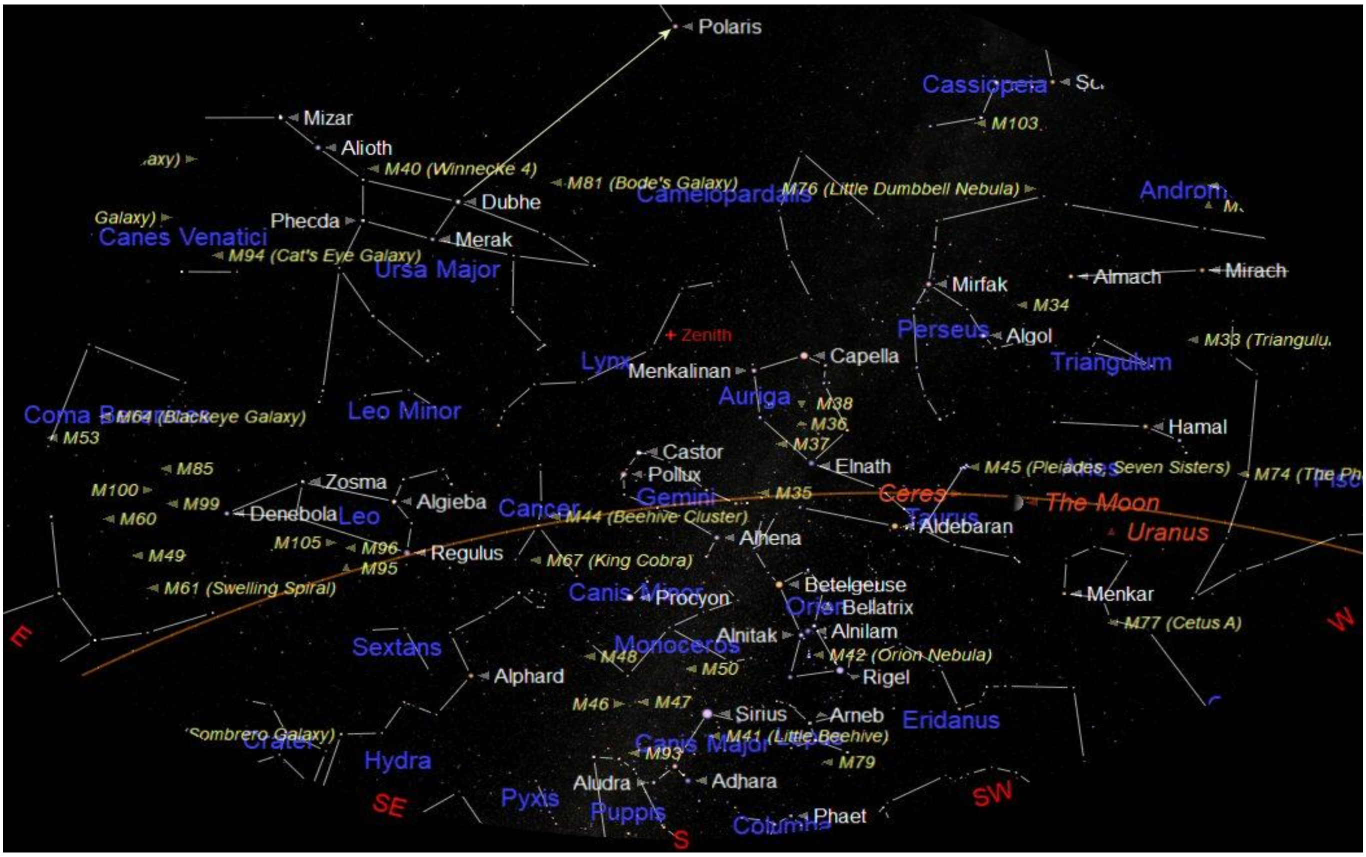
The JWST will loop around the L2 point as shown in the diagrams opposite. This looping around the L2 point helps the telescope maintain its stable position as it effectively orbits the Sun with the assistance of Earth. Unfortunately JWST cannot hide in Earth's shadow because it needs to remain in sunshine to provide power through its Solar Panel Array.



The operational James Webb Space Telescope

After arriving at L2 the JWST will spend a few months testing and tuning all its systems to ensure everything is working correctly. It is hoped that it will start observing and transmitting its findings back to Earth in July.

A TOUR OF THE NIGHT SKY - FEBRUARY 2022



The chart above shows the night sky looking south at about 22:00 GMT on 15th February. West is to the right and east to the left. The point in the sky directly overhead is known as the Zenith and is shown (in red) at the upper centre of the chart. The curved brown line across the sky at the bottom is the Ecliptic or Zodiac. This is the imaginary line along which the Sun, Moon and planets appear to move across the sky. The brightest stars often appear to form a group or recognisable pattern; we call these 'Constellations'.

Constellations through which the ecliptic passes this month are: Aquarius (the Water Carrier), Pisces (the Fishes), Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion) and Virgo (the virgin).

The southern sky is now dominated by the constellation of Taurus (the Bull). The most obvious star in Taurus is the lovely Red Giant Star called Aldebaran. It appears slightly orange to the 'naked eye' but it is very obviously orange when seen using binoculars or a telescope. Aldebaran is located at the centre of the 'flattened' X shape formed by the brightest stars in Taurus. At the end of the top right (upper west) arm of the 'X' is the beautiful 'naked eye' Open Star Cluster called Messier 45 (M45) also known as the Pleiades (or the Seven Sisters). It really does look magnificent using binoculars.

Following Taurus is the constellation of Gemini (the Twins). The two brightest stars in Gemini are Castor and Pollux and they are named after mythological twins. To the north of Taurus is the odd pentagon shape of Auriga (the Charioteer). Dominating Auriga is the brilliant white star Capella which is almost directly overhead. For those with a telescope there is a line of lovely open clusters to search out in Taurus and Auriga. These are M35 in Taurus and M36, M37 and M38 in Auriga.

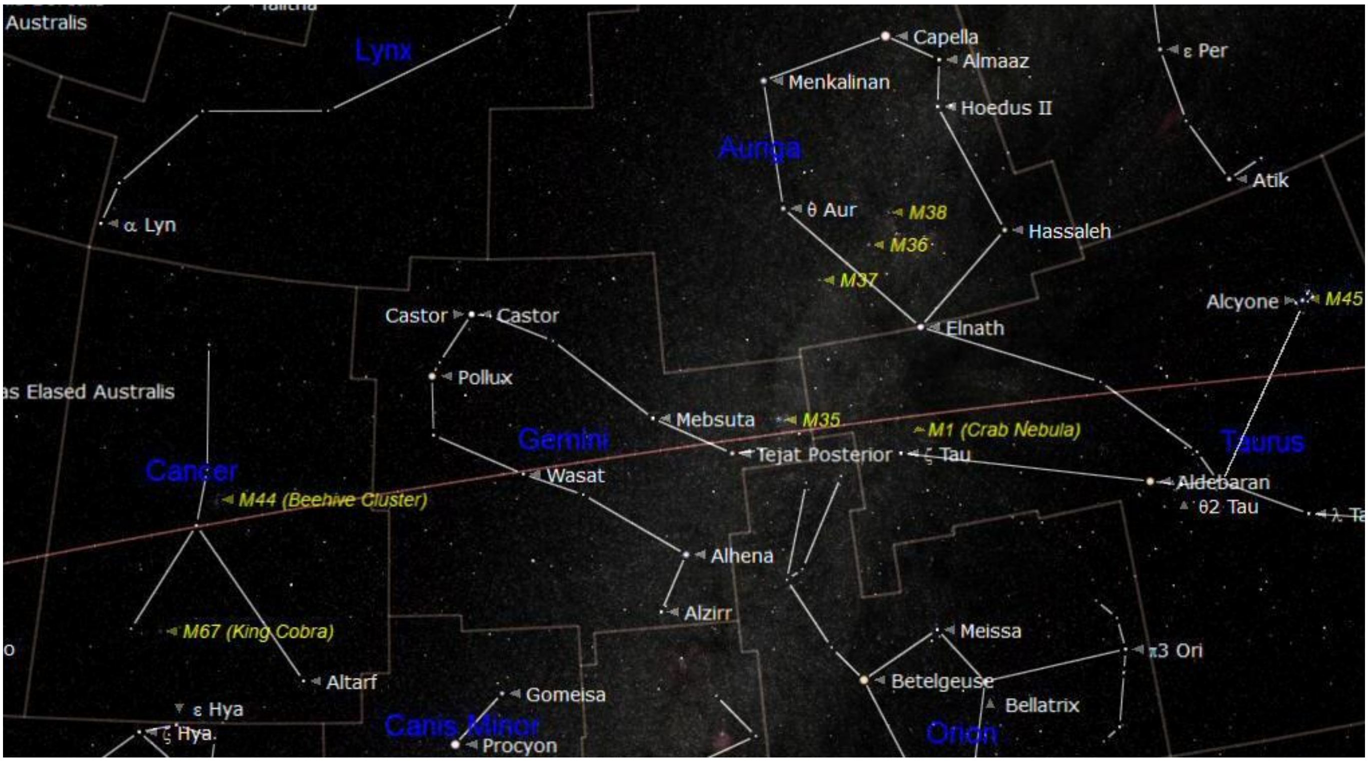
To the south of Taurus is the winter constellation of Orion (the Hunter) that dominates the southern night sky. Orion is easily found by looking for the very obvious three stars of his belt. As he is so easy to find it is a good place to start exploring the sky. Orion has his Hunting Dogs Sirius (the big dog) and Procyon (the little dog) to the east (left) and following him. Orion was featured as constellation of the month in the January magazine.

To the east (right) of Taurus is the rather indistinct constellation of Cancer (the Crab). The stars of Cancer are quite faint and can be difficult to discern especially in a light polluted sky. It is really worth searching out Cancer using binoculars or a telescope to see the Open Cluster M44 (the Beehive Cluster). M44 is older and further away than M45 (the Seven Sisters) so is fainter than M45 but still looks lovely. It has a group of stars that resemble an old straw Beehive with bees around it.

The constellation of Leo (the Lion) follows Cancer along the Ecliptic and will be the constellation of the month next month. It does actually look a little like a lion or the Sphinx in Egypt. Around and between Leo and the neighboring constellation of Virgo is a cluster of galaxies. Our Milky Way galaxy and our local group of galaxies are members of this larger group of galaxies called the Virgo Cluster. A medium sized telescope (150mm to 200mm) and a dark sky is required to see these faint objects.

The Ecliptic was low in the sky during the summer months but now it appears high in the night sky so the Moon and planets also appear high. Planets Neptune, Saturn, Jupiter, Venus and Mercury have moved over the western horizon and are now moving into the very early morning sky. Uranus is still well placed for those who are fortunate enough to have access to a telescope. Mars is still located on the other side of the Sun so it appears small, close to the Sun and difficult to see.

CONSTELLATIONS OF THE MONTH – AURIGA, GEMINI AND CANCER



The constellations of Auriga, Gemini and Cancer

The chart above shows the winter constellations of Auriga (the Charioteer), Gemini (the Twins) and Cancer (the Crab). These are interesting constellations to search out and have some very interesting objects to see even when using just a pair of binoculars. Gemini and Cancer are located on the Ecliptic and therefore are occasional hosts to the Sun, Moon and Planets as they appear to move along this imaginary line.

Capella is the brightest star in the constellation of Auriga, it is the sixth-brightest star in the night sky and the forth-brightest in the northern celestial hemisphere after Sirius, Arcturus and Vega. A prominent object in the northern winter sky, it is circumpolar to observers north of 44°N. Its name means "little goat" in Latin. Capella is depicted as the goat Amalthea that suckled Zeus in classical mythology. The Capella system is relatively close, at only 42.9 light-years from the Sun.

Although it appears to be a single star to the naked eye, Capella is actually a quadruple star system with two binary pairs made up of the stars Capella Aa, Capella Ab along with Capella H and Capella L.

The first pair, Capella Aa and Capella Ab is composed of two bright yellow giant stars, both of which are around 2.5 times as massive as the Sun. The second pair, Capella H and Capella L are positioned around 10,000 astronomical units (AU) from the first pair and are two faint, small and relatively cool red dwarfs.

Auriga has three Messier Open Clusters that can be seen using binoculars. These are M36, M37 and M38. See the chart above. Open Clusters are groups of stars that have formed from the gas and dust in a Nebula (large cloud of gas and dust). These clusters look like small smudges of light using binoculars. They are best seen using a telescope which will show many of the individual stars in the clusters.

During the midwinter months Capella is almost directly overhead which makes it very easy to find. During the summer months it can be seen close to the northern horizon. The Milky Way (our galaxy) passes through Auriga and can be seen on the chart above. The three open clusters in Auriga are seen against the dense star fields of the Milky Way.

The constellation of Auriga is joined to the constellation of Taurus at the most southerly star of Auriga called Elnath. Oddly Elnath is actually included in the lists of the stars belonging to both constellations.

There is a fourth Open Cluster that appears to be in the same line as M36, M37 and M38 over the border in the constellation of Gemini, this is Messier 35 (M35). Gemini is named after the mythical twins Pollux and Castor from Greek mythology.

The recognised shape of Gemini is in the form of a rough rectangle with Pollux and Castor at the eastern short side. A line of stars runs south west from Castor to the star Tejat Posterior. The line from Pollux takes a diversion south through kappa (κ) then south west through Wasat to Alhena and Alzirr.

The two brightest stars in Gemini are Castor and Pollux which look quite similar and represent the twins. Castor and Pollux were the children of Leda. However Pollux was actually the son of Zeus who seduced Leda but Castor was the son of Tyndareus, King of Sparta and Leda's husband.

Gemini is easy to find because its two brightest stars are quite close together and similar in appearance. The two brightest stars are called Pollux (β) and Castor (α) and are known as the Gemini Twins. Although Castor has been given the Greek letter designation α (alpha), which is normally given, to the brightest star in a constellation, Castor is not actually the brightest Pollux is in fact the brighter of the two.

The open Clusters in Auriga and Gemini

Messier 36 (M36)

Messier 37 (M37)

Messier 38 (M38)

Messier 35 (M35) and NGC2158

Pollux is brighter at magnitude +1.59 compared to the +1.9 of Castor. However Castor is a double star with a fainter companion that has a magnitude of +2.9 and separated by 6 arc-seconds. The two stars, known as Castor A and Castor B, orbit their common centre of gravity every 467 years. The pair can be separated in a 75mm aperture telescope on a good clear night.

Messier 35 (M35) is located at the end of the upper of the two lines of stars that emanate from Pollux and Castor. It is the most spectacular of the four Open Clusters and is shown above.

Cancer is a faint and rather indistinct constellation but it does have a rather nice Open Cluster called Messier 44 (M44) Praesepe or 'the Beehive Cluster'. The stick figure shape of Cancer is an up-side-down letter 'Y'. Although M44 is large, the stars are dispersed and fairly faint. It is quite difficult to find in a light polluted area so will require binoculars to see it. See the chart on page 7.

Messier 44 (M44) Praesepe the Beehive Cluster

Open Star Clusters are listed in Charles Messier's Catalogue along with other objects of interest to amateur astronomers. Messier listed these objects along with Globular Clusters, Nebulae and Galaxies so they would not be mistaken for the comets he was searching for. Many of the brighter open clusters do look quite comet-like when viewed through binoculars. They are as the name suggests clusters of related stars and many are very beautiful to look at.

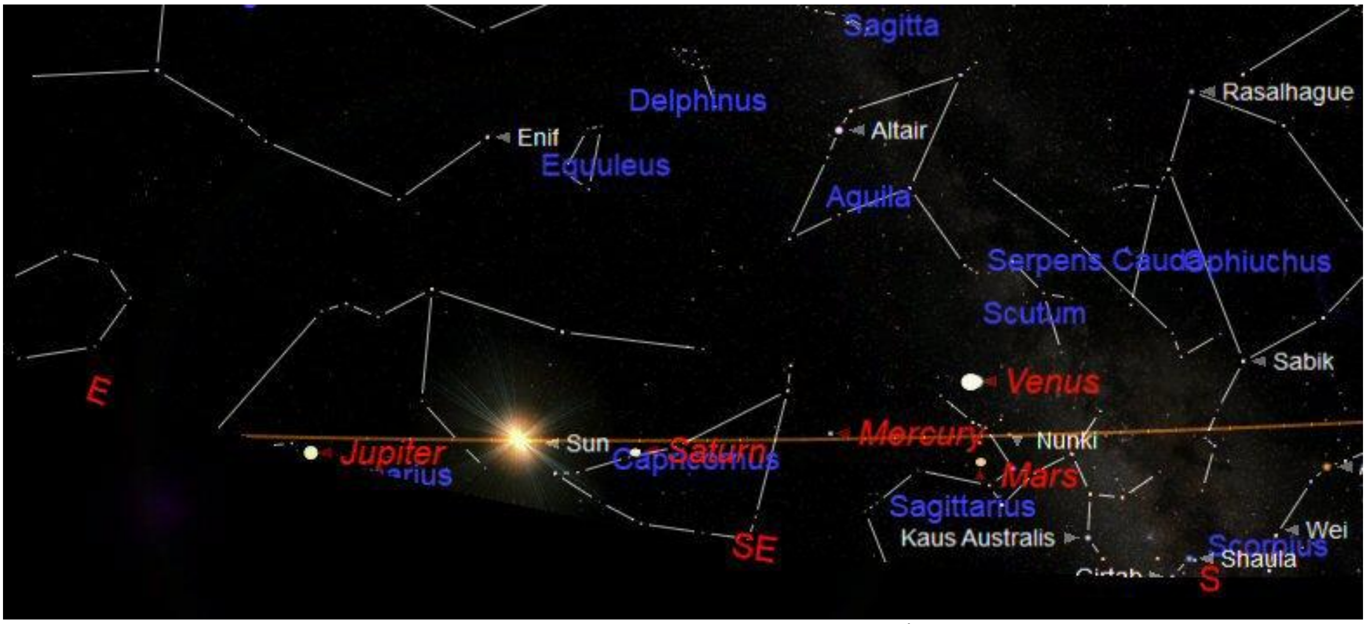
It is thought all stars form in vast clouds of gas and dust known as Nebulae (singular Nebula). Gravity pulls the atoms together into denser clumps until the gas and dust is compressed into very dense spheres. The temperature and pressure in the centre of the spheres rises until Nuclear Fusion begins. The Nuclear Fusion in the core produces an enormous amount of energy and the spheres begin to shine as stars and an Open Star Cluster is formed.

The brightest and most easily seen Open Cluster is Messier 45 (M45). See the chart on page 7. This is a cluster of about 300 stars in the constellation of Taurus. The cluster is known as the Pleiades but even more widely known as the Seven Sisters.

Six or possibly seven of the brightest stars in M45 are easily visible to the naked eye in a clear dark sky. They occupy an area of sky about the same size as the full Moon. Using a pair of 10 x 50 binoculars another thirty or so fainter stars can be seen embedded within the Seven Sisters.

The clusters M35, M36, M37 and M38 are further away so appear smaller and fainter. They can just about be seen using binoculars but a telescope is required to see them well. M35 is particularly lovely as it has a spectacular string of stars that appear to cascade through its centre and cluster NGC2158 is close by.

THE SOLAR SYSTEM - FEBRUARY 2022



The location of the planets at 08:00 GMT on 15th February 2022

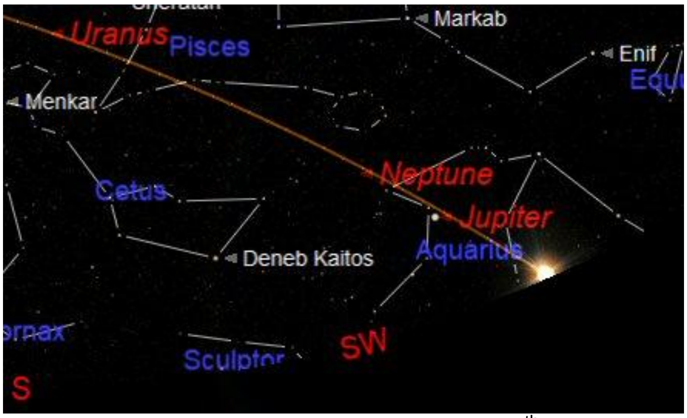
The chart above shows the location of the planets along the Ecliptic after sunrise in the east. The sky has been darkened to make the planets visible. The planets are: Mercury, Venus, Mars and Saturn. They are visible along the Elliptic from the West (right) to East (left). The planets appear low in the sky, in the bright morning sky and are not well positioned for observing.

MERCURY will be very close to Venus before sunrise in the west but will be difficult to see this month. It was in conjunction with the Sun on 23rd January

VENUS is moving out from its inferior conjunction on 9th January and is looking very bright in the east at sunrise. It will be at its largest diameter but its narrowest crescent and is called the 'Morning Star' at this time.

MARS is on the other side of the Sun (so appears very small) and still appears close to the Sun so will be difficult to see. Mars has moved out of conjunction with the Sun and into the early morning sky but will not appear in the evening sky again until September 2022.

JUPITER will be very close to the Sun on the western horizon at sunset and will be in conjunction on 5th March.



Jupiter, Uranus and Neptune at sunset 15th February

SATURN will be in conjunction on 4th February so will be appearing in the morning sky before sunrise. It will be very low over the eastern horizon in the brightening sky and will be moving into the evening sky later in the year.

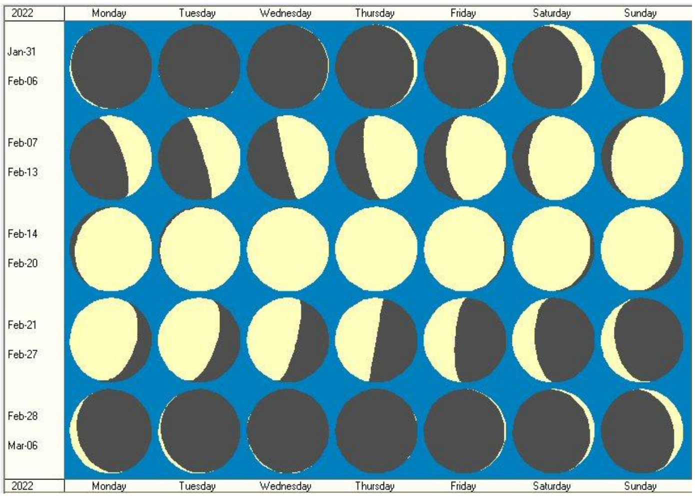
URANUS will be observable this month and will be best seen at 21:00 when it will be due south and at its highest point above the horizon but it is small and faint at +5.7.

NEPTUNE will be very difficult to see to the east of Jupiter and in the darkening sky at 17.00 as the sun sets. It is small and difficult to see at only 2.9 arc-seconds in diameter and at magnitude +7.7.

THE SUN

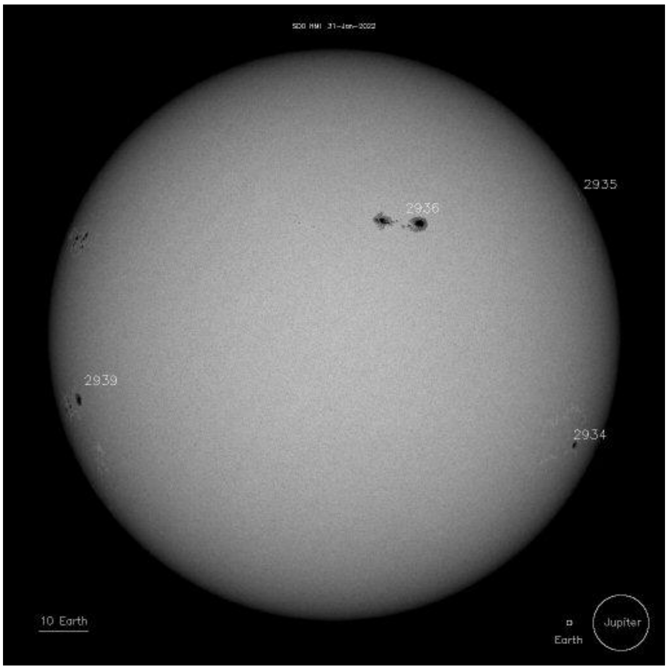
The Sun rises at about 07:30 at the beginning of the month and 07:00 by the end. It sets at 16:55 at the beginning of the month and 17:40 at the end of the month. It was at its lowest point in the sky on 21st December (Winter Solstice) and will be half way to midsummer on 20th March Spring (Vernal) equinox. Midsummer will be on 21st June (Summer Solstice) when it will be the longest day at 16 hours and the shortest night at just 8 hours long. There have been a few nice Sunspots recently, see page 10.

THE MOON PHASES DURING FEBRUARY

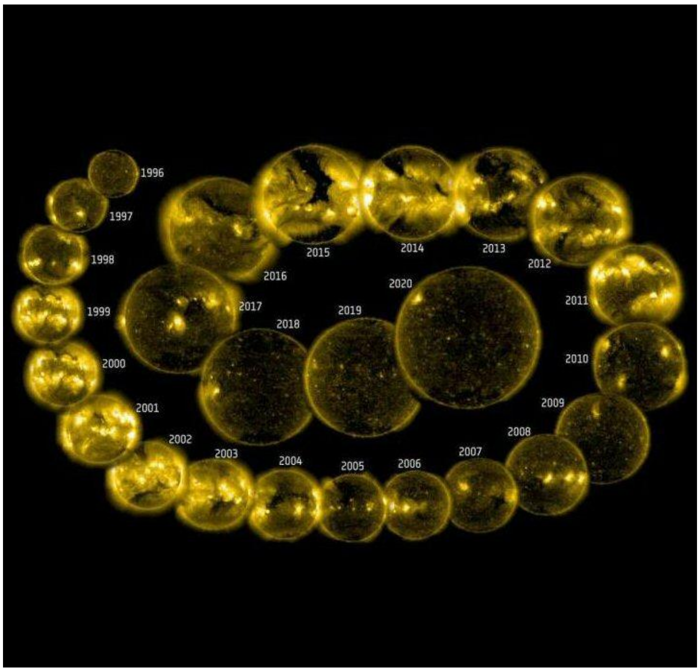


New Moon will be on 1st February
First Quarter will be on 8th February
Full Moon will be on 16th February
Last Quarter will be on 23rd February

SOLAR ACTIVITY AND SUNSPOTS



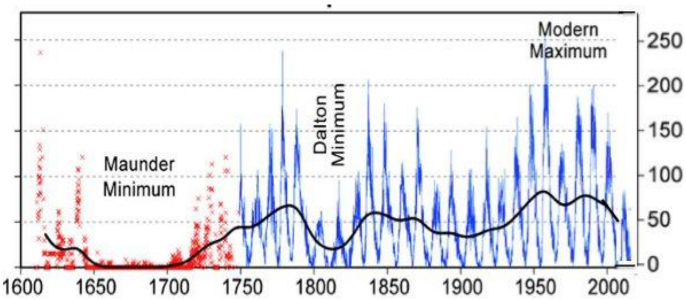
Sunspots seen on 31st January 2022



Solar Activity Cycles 1996 to 2020

Those of us who observe the Sun and follow the Sunspot Cycles have noticed that the numbers of sunspots appearing on the Sun have started to increase. There is an eleven year cycle when sunspots increase over a period of about five years and then decrease over the following five years.

Records have been kept over the last 25 cycles and it has been seen that maximum and minimum of each cycle appear to vary over a number of cycles producing a longer cycle of cycles. The chart below shows graphically the numbers of the Solar Cycles of sunspot numbers over the last 400 years. The numbers recorded in each cycle are shown on the right side of the graph.

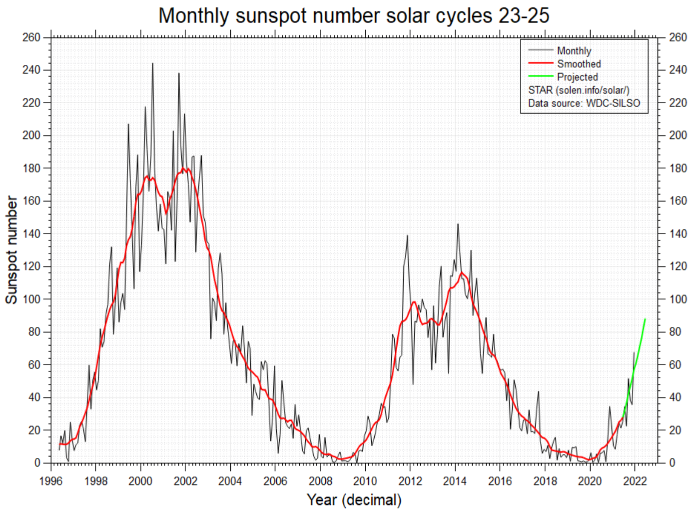


Sunspot Cycles 1600 to 2020

The main solar cycle has a period of about 11 years but there is not an exact transition point so the cycle period is just approximately 11 years. The chart above shows the 24 cycles that have been recorded since the early 1600's. The red section (on the left) shows informal records that were available before more formalised records began around 1750.

It can be seen that there are variations in the average activity on the Sun as indicated by the black line that shows the mean variations. Sunspots are easy to follow if you are fortunate to have even a modest telescope. A simple but suitable solar filter can be fitted to any type or size of telescope. The filter can be bought from a telescope supplier as a ready-made item to fit directly to the open end of a telescope. A solar filter can also be made using a sheet of special Milar (plastic) Solar Filter Film. This solar filter film permits only a very small proportion of sunlight through. The correct Solar Filter must be used and nothing else or permanent damage to the eye may occur.

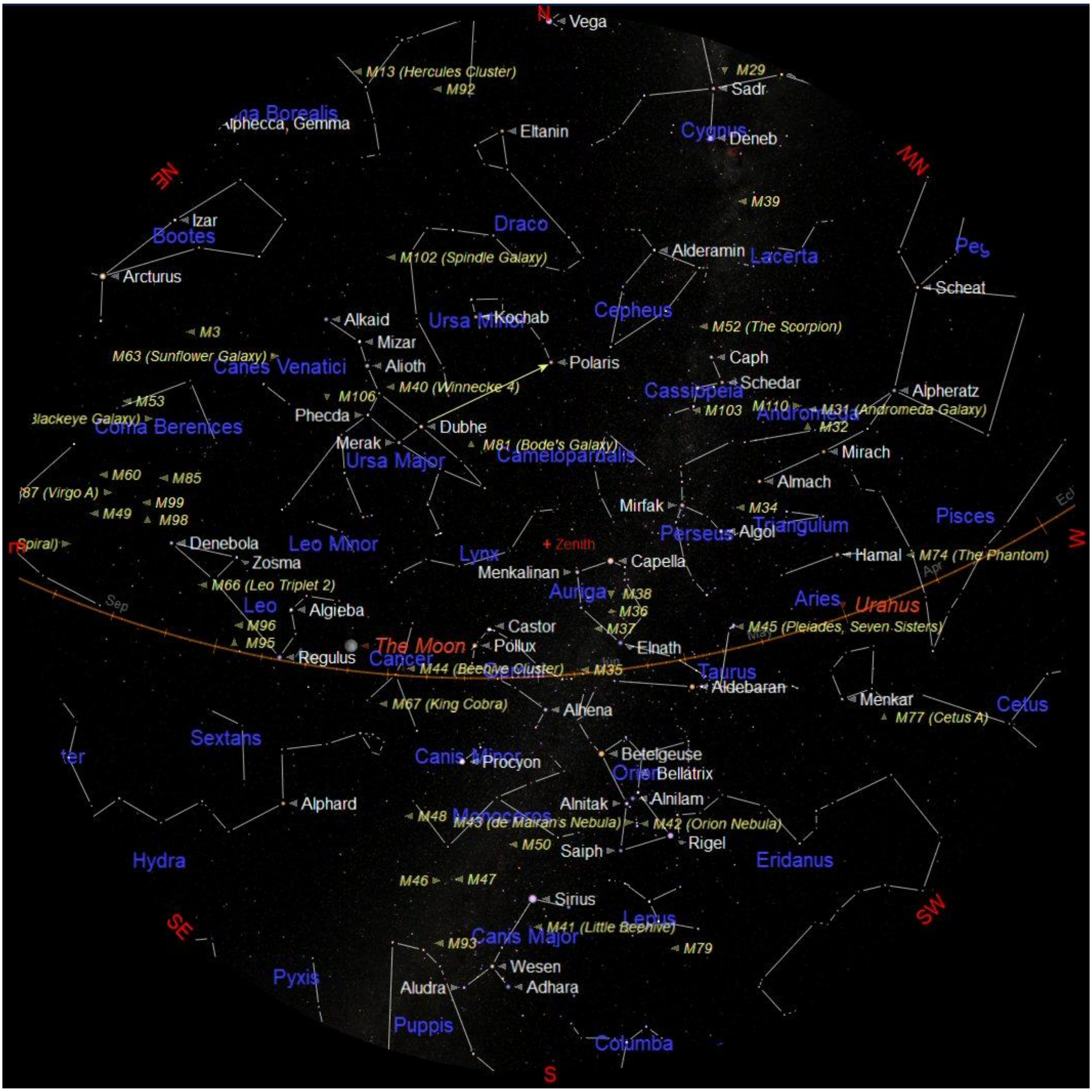
The peak of the cycles shows an increase of activity on the Sun that is usually manifested by the increase in the appearance of the number and size of Sunspots. Telescopes can be fitted with a special solar filter called a Hydrogen Alpha (Hα) filter. This type of filter allows the surface of the Sun to be seen in great detail. It will also allow flares, known as 'Prominences', to be seen erupting from the edge of the Sun.



Solar Cycles 23, 24 and 25 (current cycle)

The chart above shows the last two Solar Cycles numbers 23 and 24 and the beginning of the predicted current cycle number 25. Cycles 22 - 24 seem to indicate that we may be entering a period of lower activity. The trend of the last three peaks, shown on the chart in the previous column, appears to indicate a fall in solar activity. However the current prediction (green) appears to show increasing activity.

THE NIGHT SKY – FEBRUARY 2022



The chart above shows the whole night sky as it appears on 15th February at 21:00 (9 o'clock) Greenwich Mean Time (GMT). As the Earth orbits the Sun and we look out into space each night the stars will appear to have moved across the sky by a small amount. Every month Earth moves one twelfth of its circuit around the Sun, this amounts to 30 degrees each month. There are about 30 days in each month so each night the stars appear to move about 1 degree. The sky will therefore appear the same as shown on the chart above at 8 o'clock GMT at the beginning of the month and at 10 o'clock GMT at the end of the month. The stars also appear to move 15º (360º divided by 24) each hour from east to west, due to the Earth rotating once every 24 hours.

The centre of the chart will be the position in the sky directly overhead, called the Zenith. First we need to find some familiar objects so we can get our bearings. The Pole Star **Polaris** can be easily found by first finding the familiar shape of the Great Bear 'Ursa Major' that is also sometimes called the Plough or even the Big Dipper by the Americans. Ursa Major is visible throughout the year from Britain and is always quite easy to find. This month it is high in the North East. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.

Planets observable in the evening sky: Neptune (in the early evening) and Uranus later.