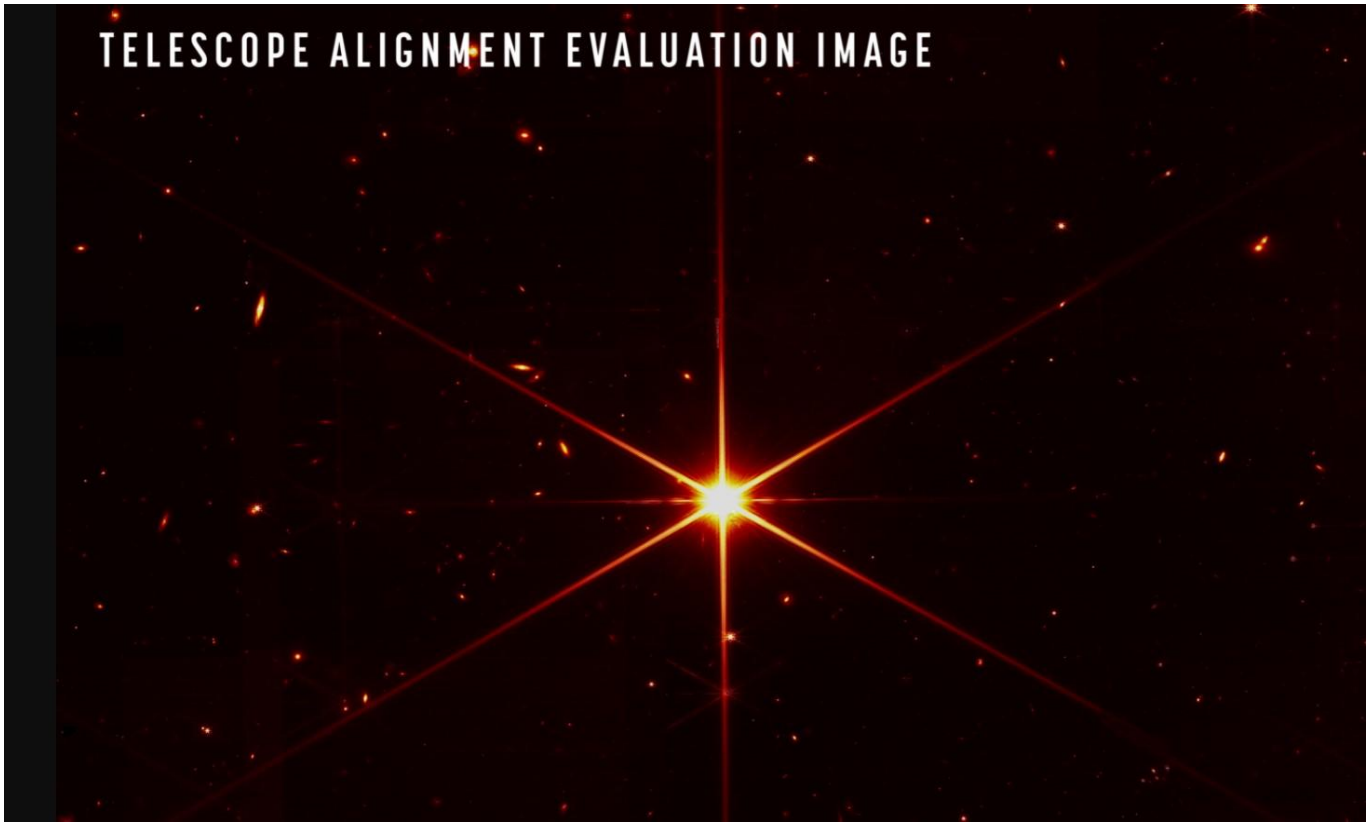
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – APRIL 2022

The latest news from the James Webb Space Telescope



The first image from the JWST with the mirrors aligned

Engineers and scientists working on the James Webb Space Telescope have completed two more steps in the telescope's primary mirror alignment process. At a briefing, officials said JWST's optical performance appears to be better than even the most optimistic predictions.

The team released a new engineering image showing the star 2MASS J17554042+6551277 in crisp clarity. This image demonstrates that all 18 mirror segments have been precisely aligned to act as one giant, high-precision 6.5-meter (21.3-foot) primary telescope mirror.

The team has now achieved what's called 'diffraction limited alignment' of the telescope. The mirrors are focused together as finely as the laws of physics allow and have taken the sharpest image that can be achieved from a telescope of this size.

The team still needs to make some very small adjustments to bring the telescope to even more exquisite sharpness. At no point the process did the science and engineering team have any issues with any of the deployments. The results are far closer to the hoped-for predictions than could ever have expected.

James Webb has now completed steps four and five of the seven-step, three-month long alignment process. All 18 mirror segments are now aligned into a single mirror. This image is a 2,100 second exposure and taking an image over that length of time allows the team to assess several aspects of the telescope's performance. Not only is the optics system working perfectly but other systems are working well too. This includes the fine guidance sensors and reaction wheels that allow the telescope to point precisely and stay on target.

The star 2MASS J17554042+6551277, is a generic, anonymous, average star chosen for its brightness – or lack thereof. It is 100 times fainter than what the human eye can see but in the image it looks blindingly bright.

The mirror alignment process, called phasing, began in early February. Seven different steps takes the mirrors' initial placements after they were deployed to doing a 'coarse' and then 'fine' alignment. Then making sure the mirror works with all four of Webb's instruments and their various fields of view.

The scientists expect Webb to be fully commissioned by the end of June. One of the key instruments, the MIRI or mid-infrared instrument still needs to continue cooling down to 7ºK (7º degrees above absolute zero) it is currently at about 90ºK.

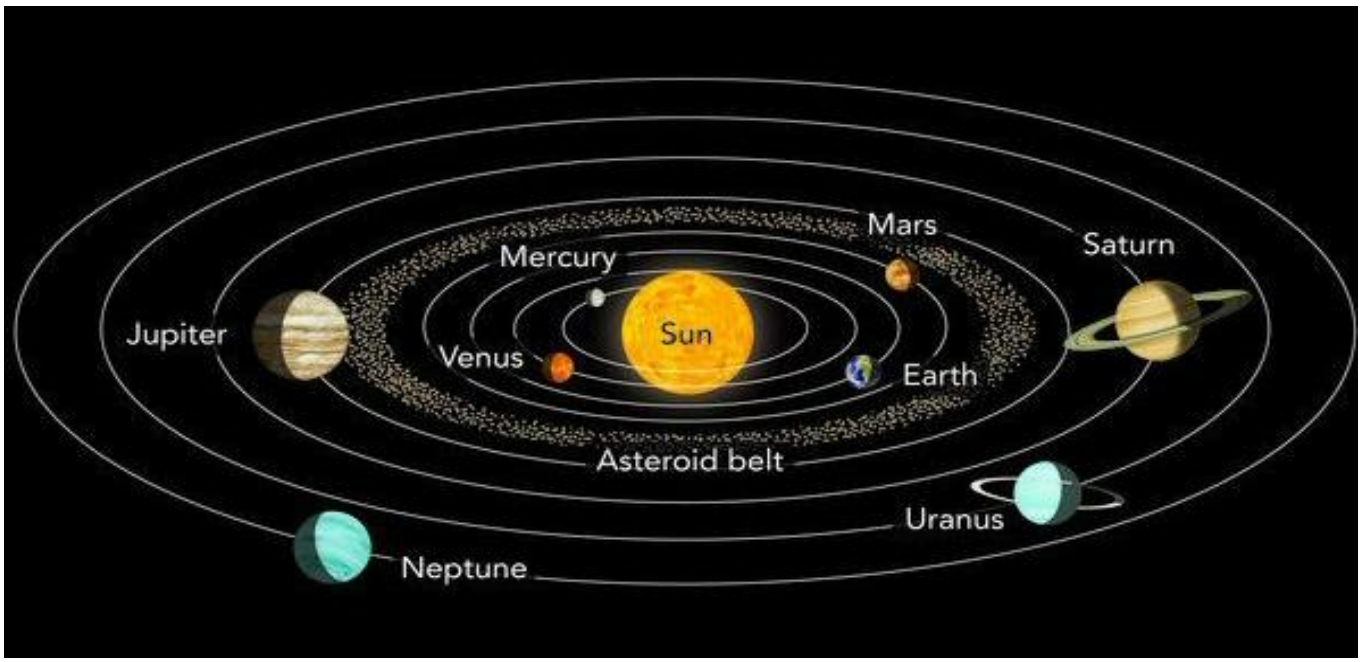
NEWBURY ASTRONOMICAL SOCIETY MEETING

1st April	Sixty Years in Space - Richard Fleet
Website:	www.newburyastro.org.uk

NEXT NEWBURY BEGINNERS MEETING

20th April	Where do we live in the Universe?
Website:	www.naasbeginners.co.uk

OUR PLACE IN THE UNIVERSE



Our Solar System and the Sun's family

The chart above shows the Sun, main planets and minor planets that make up our Solar System. Let us first clarify the terms we use. Our Sun is a star and is in many ways a very ordinary star. A star is a dense cloud of mainly Hydrogen with about 11% Helium. This cloud of gas has been compressed by gravity into its most compact shape which is a sphere. The enormous force of gravity produces Nuclear Fusion in the centre (core) that powers the star and causes it to shine.

Planets, like our Earth, are objects that orbit a star and have cleared paths from the original disc. They have grown massive enough to become spherical. Our Solar System has eight main planets that, in order out from the Sun, are called: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. See the chart above.

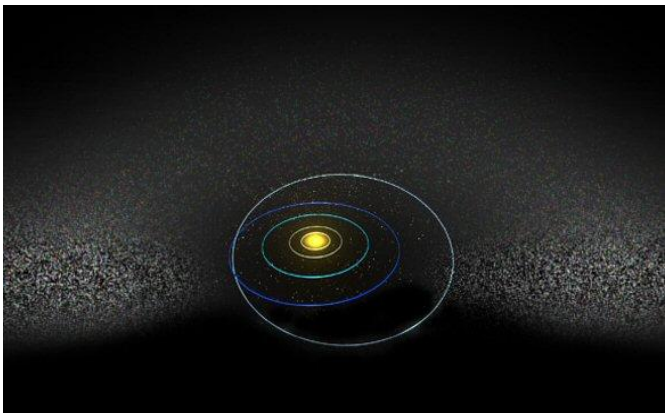
There are also smaller objects orbiting the Sun that we have called Minor Planets. These objects mainly orbit in specific zones around the Sun. Minor Planets that are large enough to become Spherical (over 300 to 500 km depending on composition) are called Dwarf Planets.

ASTEROIDS are mostly found between the orbits of Mars and Jupiter in what is known as the Asteroid Belt but there are some special groups of asteroids that orbit outside this zone. The sizes of these objects are from a few metres to a few hundred kilometres. They are mainly comprised of rock and Iron.

DWARF PLANETS are found beyond the orbit of the outermost main planet Neptune. These are composed mainly of water ice and frozen gases. When the Solar System first formed the Sun was more powerful than it is now and produced powerful ultraviolet radiation. Any volatile materials on the inner planets were vaporised by the radiation and blown away into the outer reaches of the developing Solar System. Here these volatile materials cooled and froze into ice that accumulated into objects up to a few thousands of kilometres in size.

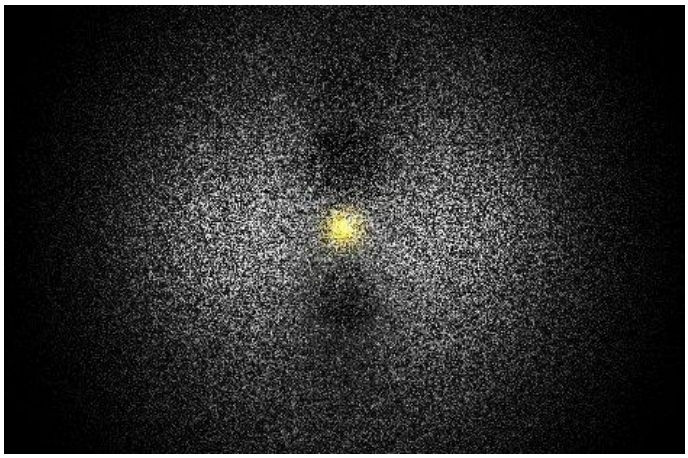
There are vast numbers of these Dwarf Planets orbiting the Sun beyond the orbit of the outermost main planet Neptune so Pluto is just the closest of these objects.

This Minor Planet Zone beyond the orbit of Neptune is called the Kuiper Belt and may contain millions of icy objects with many up to the size of Pluto. This is why the decision was made to reclassify Pluto. So far there have been over 4000 objects, like Pluto and about the same size that have been found, identified and named.



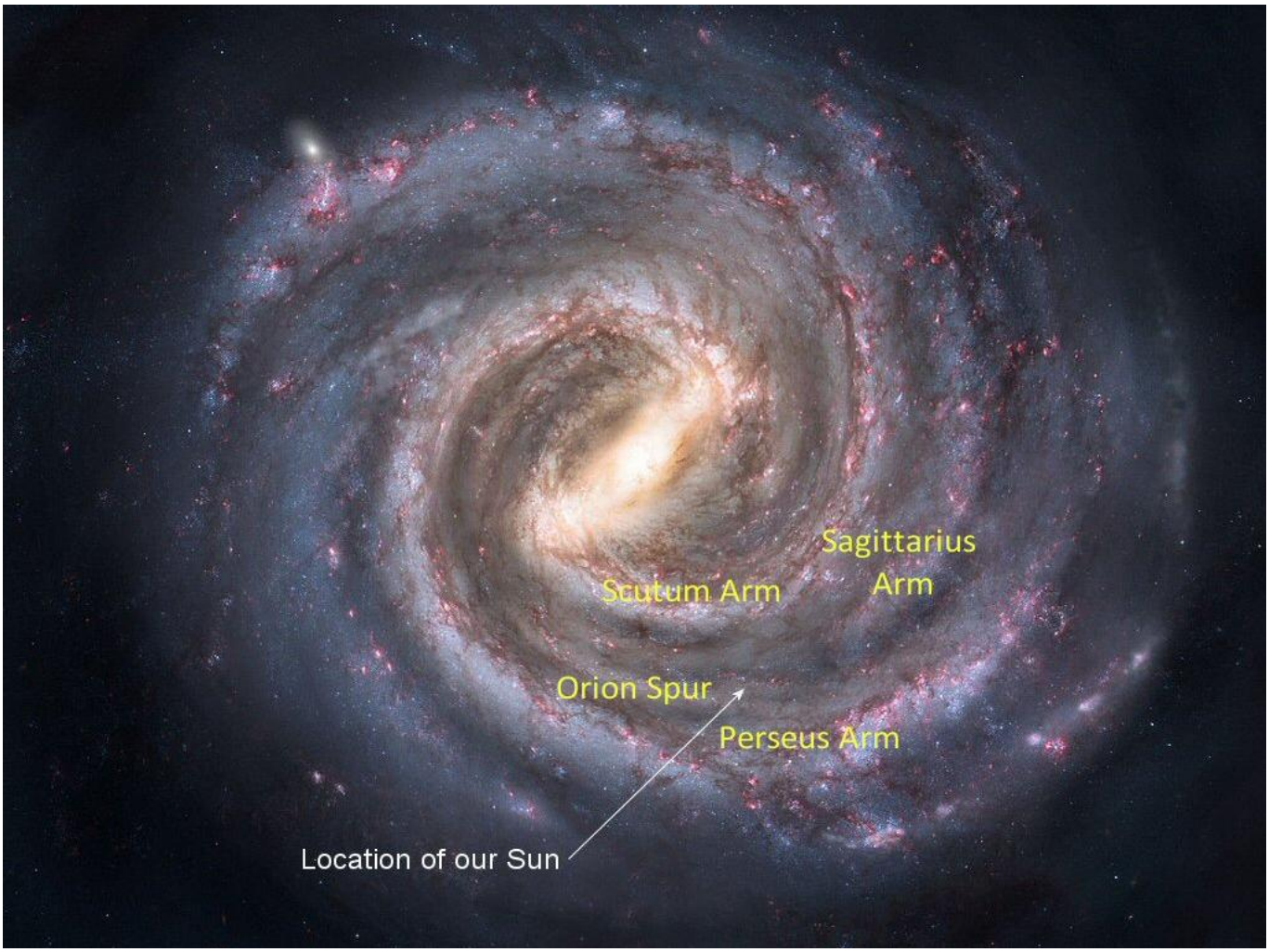
The Kuiper Belt beyond the orbit of Neptune

There is also thought to be a halo of icy objects beyond the Kuiper Belt and surrounding the Sun that is called the Oort Cloud but these objects are too far away to detect.



The Oort Cloud

THE LOCATION OF OUR SOLAR SYSTEM IN OUR GALAXY



An artist's impression of our Galaxy and the position of our Sun

Stars form in vast clouds of gas and dust, called Nebulae that are located in the arms of Spiral Galaxies. Galaxies are huge rotating discs of stars, gas and dust where hundreds of billions of stars form. The spiral arms of these galaxies are created by shock waves of star formation moving through the nebulae. These shock waves stir up the gas and dust causing the atoms to swirl around and be drawn together by gravity.

The Pillars of Life Nebula imaged by Hubble

Dense clumps of gas develop and pull in more gas and dust as they grow and their gravity increases. These dense clouds begin to spin and form into a flat disc of rotating gas and dust.

As more and more material is pulled in by the increasing gravity the centre of the disc is compressed and begins to heat up. This core becomes so compressed it is forced into its most compact shape, a ball or sphere. Eventually the pressure and temperature become so great that the Hydrogen atoms are pressed together until they fuse and are transformed into a Helium atom. This process is called Nuclear Fusion that produces huge amounts of energy and a shining new star is born.

Other stars form in the Nebula creating a group of stars that blow away any remaining gas to reveal a new cluster of stars called an Open Custer. Our Sun was one star in an Open Cluster of between 30 and up to about 1000 stars. Gradually the stars of the cluster that our Sun formed in drifted apart and were distributed around our Galaxy that we call the Milky Way.

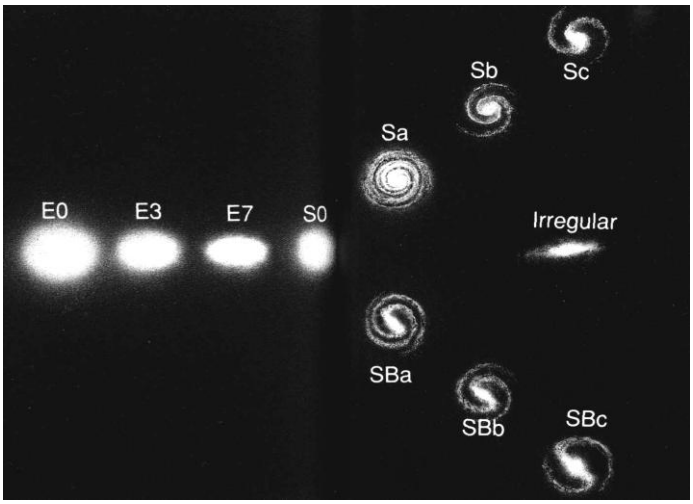
As the early Solar System formed it began to rotate. The 'left over' gas and dust formed into a flat disc around the developing star. In this disc, larger clumps of material formed under the force of gravity. These dense clumps of gas and dust developed into planets and gradually cleared paths around the star to establish a clear orbital path for each planet.

Our star, that we call the Sun, is located close to the Orion Spur between the Perseus Spiral Arm and the Scutum Spiral Arm. This location is shown on the artist's impression of the disc structure of our Milky Way Galaxy shown above.

WHAT ARE GALAXIES?

The galaxies mentioned on page 3 are all spiral galaxies but there are other types. The first galaxies to form were closer together than galaxies we see around us today and they were subtly different. The theories of galaxy formation that we use at the moment suggest that galaxies were smaller when they first formed but larger galaxies may have grown through the merging of smaller ones into larger ones.

Galaxies are classified into four types, these are: Elliptical, Spiral, Barred Spiral, and Irregular. Elliptical galaxies are generally the largest and Irregulars the smallest. The great American astronomer Edwin Hubble (whom the Hubble Space Telescope is named after) devised a theory about how galaxies formed. The 'Y' shaped diagram that Hubble produced to demonstrate his theory is still used today to classify galaxies and is shown below.



Edwin Hubble's classification of galaxies diagram

IRREGULAR GALAXIES

These galaxies are, as the name implies, large groups of stars but with no classifiable shape, in other words they may be any shape. Our spiral galaxy and the other close large spiral known as M31 or the Great Spiral Galaxy in Andromeda, have smaller irregular galaxies associated with them as satellite galaxies. Two of the irregular galaxies associated with our galaxy can be seen from the southern hemisphere as islands broken off the Milky Way. These are known as the Large and Small Magellanic Clouds. These two Irregular Galaxies are gravitationally tied to our Giant Spiral Galaxy (the Milky Way).

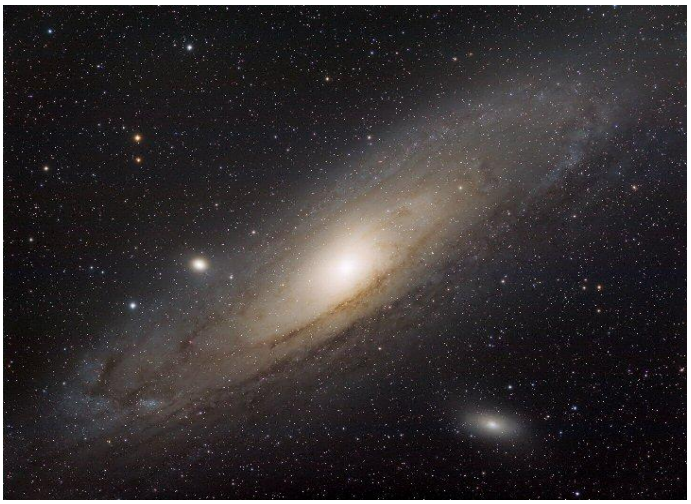
The Small and Large Magellanic Clouds

The Large Magellanic Cloud is located 163,000 light years from us and contains about 30 billion stars. The Small Magellanic Cloud is about 200,000 light years from us and contains around 3 billion stars. Both of the Magellanic Clouds have had their shapes distorted by gravitational interactions with the Milky Way. As these galaxies pass near to the Milky Way, their gravitational pull also misshapes the outer arms of our galaxy. The Large Magellanic Cloud contains a highly active 'starbirth' region called the Tarantula Nebula.

There are other small galaxies within our spiral galaxy that have already been completely pulled in by gravity and are in the process of being absorbed by our giant spiral galaxy. We can also see the same process occurring in M31 the Great Spiral Galaxy in Andromeda.

SPIRAL GALAXIES

Many galaxies are disc shaped with spiral arms. Some have arms like curved spokes in a wheel, some gently curved, some tightly wrapped around the central 'bulge'. The spiral class is preceded by 'S' for Spiral and 'SB' for Spiral Barred. Spiral and Barred Spiral galaxies are further divided into three subdivisions a, b and c depending on how tightly the arms are wound. They are therefore referred to as Sa, Sb and Sc or SBa, SBb and SBc. The Great Galaxy in Andromeda is our closest giant spiral neighbour and can even be seen with the naked eye on a very clear night and from a dark location.



Messier 31 the Great Spiral Galaxy in Andromeda

Spiral Galaxies generally have star formation in the spiral arms and this can be seen as blue and pink colours in the arms of our galaxy in the images on the previous page. Spiral galaxies rotate as a solid disc and not faster towards the centre due to the influence of huge amounts of dark matter that they also contain. The spiral arms are actually more like shock waves moving through the disc. As the shock wave passes through the disc, gas is compressed and stars are formed. The star formation then adds to the shock wave. The cores of Spiral Galaxies and the whole of Elliptical Galaxies have very little or no current star formation.

Our Milky Way has 200 to 250 billion stars and the Andromeda Galaxy may be up to twice the size possibly with up to 400 billion stars. All the other members of our 'Local Group' are smaller with many of them located like satellites around the two giant spiral galaxies.

BARRED SPIRAL GALAXIES

Some Spiral Galaxies have what looks like a straight bar of stars extending out from the central bulge. The spiral arms are attached to ends of the bar so these are called Barred Spiral Galaxies. It was originally thought that the 'Bar' naturally formed as normal spiral galaxies matured. However this theory is now in question and it has been suggested that the bar is formed by gravitational forces in some spiral galaxies. It is now thought that our own galaxy, the Milky Way, is a Barred Spiral Galaxy.

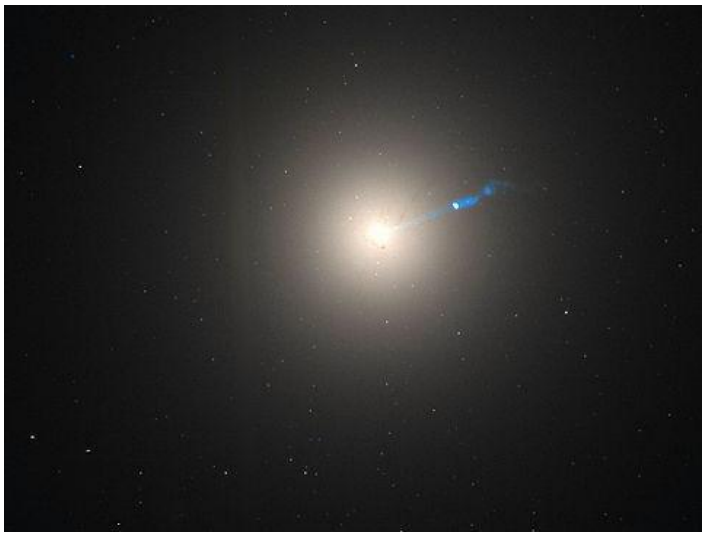
NGC1300 a Barred Spiral Galaxy

Our galaxy (the Milky Way) and M31 are classified as Giant Spiral Galaxies but there are other smaller spiral galaxies such as M33 shown below. Messier 33 (M33) is a smaller Spiral galaxy also known as the Triangulum Galaxy. The Triangulum Galaxy is approximately 3 million light-years from us and is located in the constellation Triangulum. It is catalogued as M33 or NGC 598 and is sometimes informally referred to as the Pinwheel Galaxy. It appears 'face on' to us and is thought to contain up to 40 billion stars. It also has a lot of star forming activity.

Messier 33 (M33) a smaller Spiral Galaxy

ELLIPTICAL GALAXIES

These are huge balls of stars that do not have spiral arms and are elliptical (egg shaped). Many of these Elliptical Galaxies are the largest of all star groups with some having thousands of billions (trillions) of stars. Elliptical Galaxies are classified according to how flattened they are, nearly round ones are known as E0 and sausage shaped ones E7. Most Elliptical Galaxies are far away and therefore appear very faint and need a telescope to see them.



Messier 87 (M87) a Giant Elliptical Galaxy

There are many indications that the giant elliptical galaxies grew from the collision of two or more smaller galaxies. There are indeed some galaxies which can be seen to be in the process of colliding and combining. Messier 87 is the biggest galaxy in our immediate area of the universe. It is thought to contain around 2.7 trillion stars.

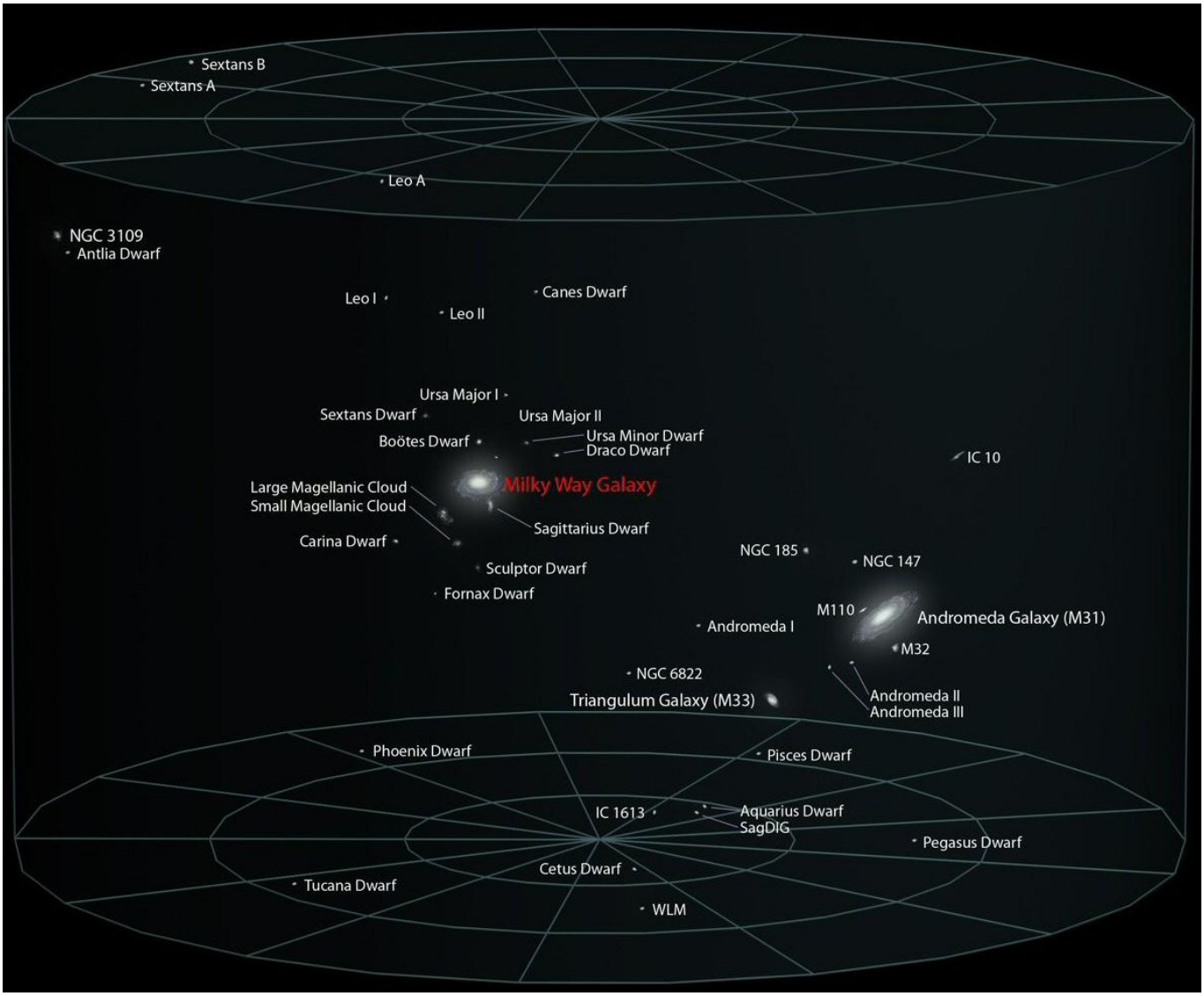
GALAXIES AND SUPER MASSIVE BLACK HOLES

In recent years it has been discovered that all galaxies (except some Irregular Galaxies) have a Super Massive Black Hole at their centre. It has also been found that there is a relationship between the size of the Black Hole and the size of the Galaxy. It appears to be a simple relationship in that the larger the galaxy the larger will be the central black hole. It has not yet been established whether the size of the galaxy depends on the size of the black hole or whether it is the other way round.

Galactic black holes are different to stellar black holes that formed when a giant star exploded as a supernova. Stellar black holes normally have a mass of about 5 to 50 times the mass of our Sun. Galactic black holes have a mass of millions of times the mass of our Sun (solar masses). The Super massive Black Hole at the centre of our galaxy is 4.1 million times the mass of our Sun and is located in the direction of the constellation of Sagittarius.

Some galaxies have an active core where material is being pulled into the central black hole. As this material (gas, dust and even stars) spirals in towards the black hole it is accelerated and heated to many millions of degrees. If the amount of material exceeds the limit that the black hole can consume it is directed by very strong magnetic fields towards the poles of the black hole. It is then ejected as jets of highly energetic particles. These jets can extend for millions of light years from the black hole. One such jet can be seen in the image of M87 above. Fortunately the super massive black hole in our galaxy is not an active one.

THE LOCATION OF OUR GALAXY AND NEAR NEIGHBOURS



The diagram above shows the immediate area around our galaxy that contains the other galaxies of our 'Close Local Group' of galaxies. Our 'Local Group' is dominated by the Great Spiral Galaxy in Andromeda and our own Milky Way Galaxy. The other members of the Local Group are smaller spiral galaxies and Irregular Galaxies. Some of the Irregular Galaxies are very small and are referred to as Dwarf Galaxies. It is thought there are between 55 and 60 members of our Close Local Group.

The centre of mass of the Local Group is located between the two Giant Spiral Galaxies and all the smaller members are dominated by these larger members. In fact the two Giant Spirals are also dominated by this centre of gravity. The gravity of the two giants is pulling them towards each other. Inevitably they will meet and collide in about 4 to 5 billion years time which coincidently is about the same time that our Sun will start to run out of its Hydrogen fuel.

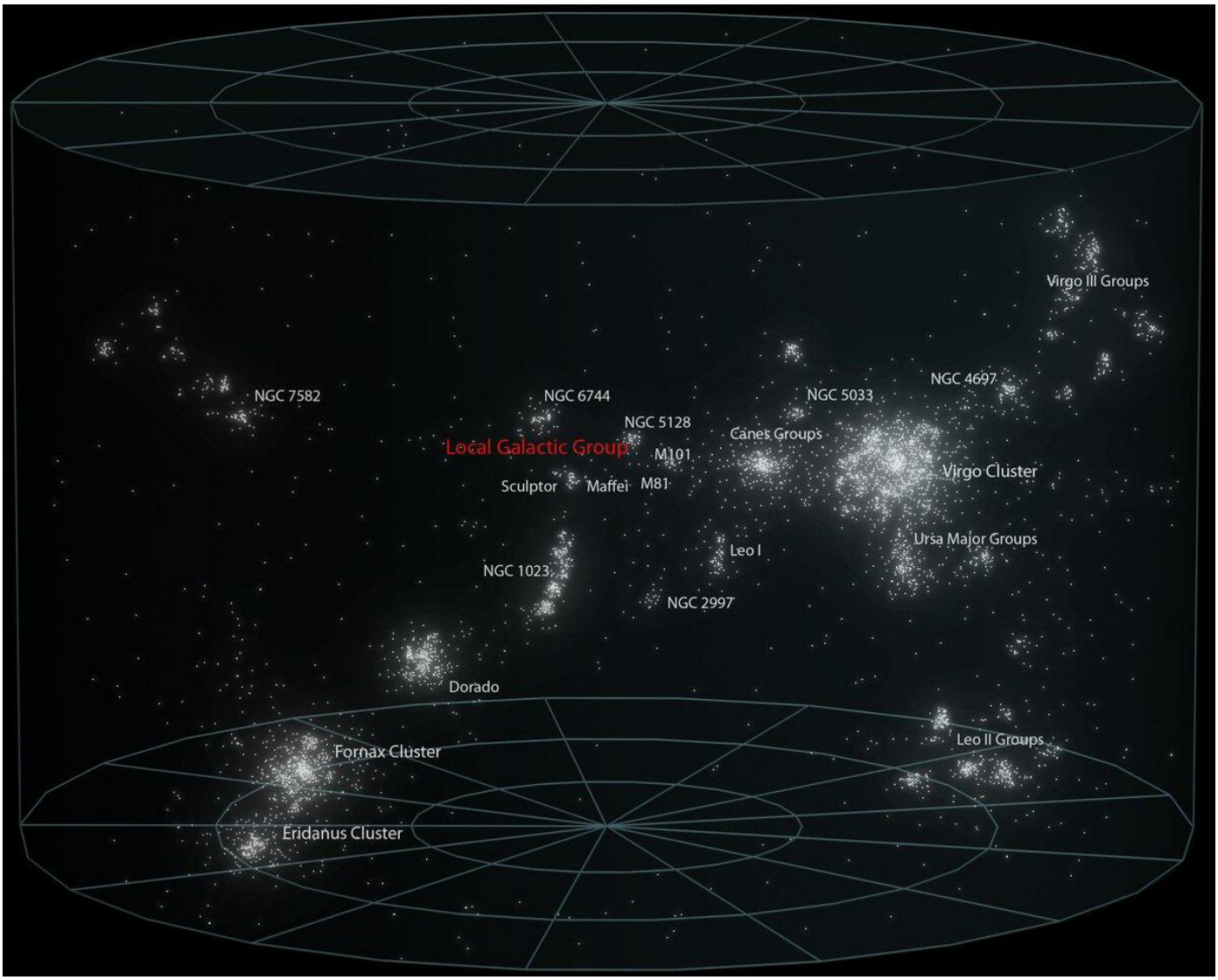
With two such enormous objects hurtling towards each other at a combined speed of 400,000 km/h we could be excused for thinking that there was an unimaginable disaster ahead. This is not necessarily going to be as bad as we might think. Before the two giant galaxies actually meet they will make an incredibly beautiful sight in the sky. M31 will fill the whole sky see the artist's impression in next column.

It is not 100% clear what will actually happen as to whether the two will collide head on or a just take a glancing pass.

An artist's impression of the imminent collision

However it occurs, the end result will be the same. The two spiral galaxies may pass through each other but very few stars will actually collide. Although stars are very large to us they are incredibly far apart from each other so the space between them is enormous. The galaxies will pass through each other like ghosts but their gravity will cause them to pirouette round each other a number of times and eventually coalesce to form a Giant Elliptical Galaxy.

THE LOCATION OF OUR CLOSE LOCAL GROUP IN OUR LARGER GROUP

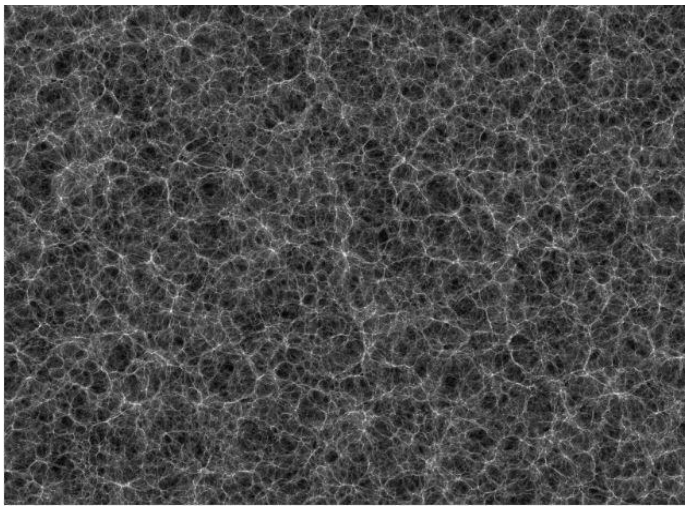


The diagram above shows the immediate area around our 'Local Group' of galaxies and its position in the wider grouping of galaxies called the Virgo Custer. The Virgo Cluster can be found in our night sky located between the constellations of Leo, Coma Berenices and Virgo. The whole area in and around these constellations is filled with galaxies of all shapes and sizes. M87 the Giant Elliptical Galaxy discussed on page 5 is located here.

Our Close Local Group is shown at the centre of the diagram above with the rest of the Virgo Cluster of galaxies gathered around it. The whole cluster is shown but the part that is located around Virgo is shown to the right of centre. All these galaxies are related and bound by their mutual gravity.

Galaxies form the overall structure of the universe. The greater structure of the universe was determined in the first 100,000 years after the Big Bang (the moment everything we know came into existence). During this first period the Universe was very hot, very dense and expanding rapidly. At that time it was completely opaque and comprised of pure energy. After about 100,000 years of expansion the universe had cooled enough for Hydrogen atoms to start to form and the structure became transparent and a flash of Gamma Rays was created. This flash can be detected today as Microwave radiation that can be detected in all directions.

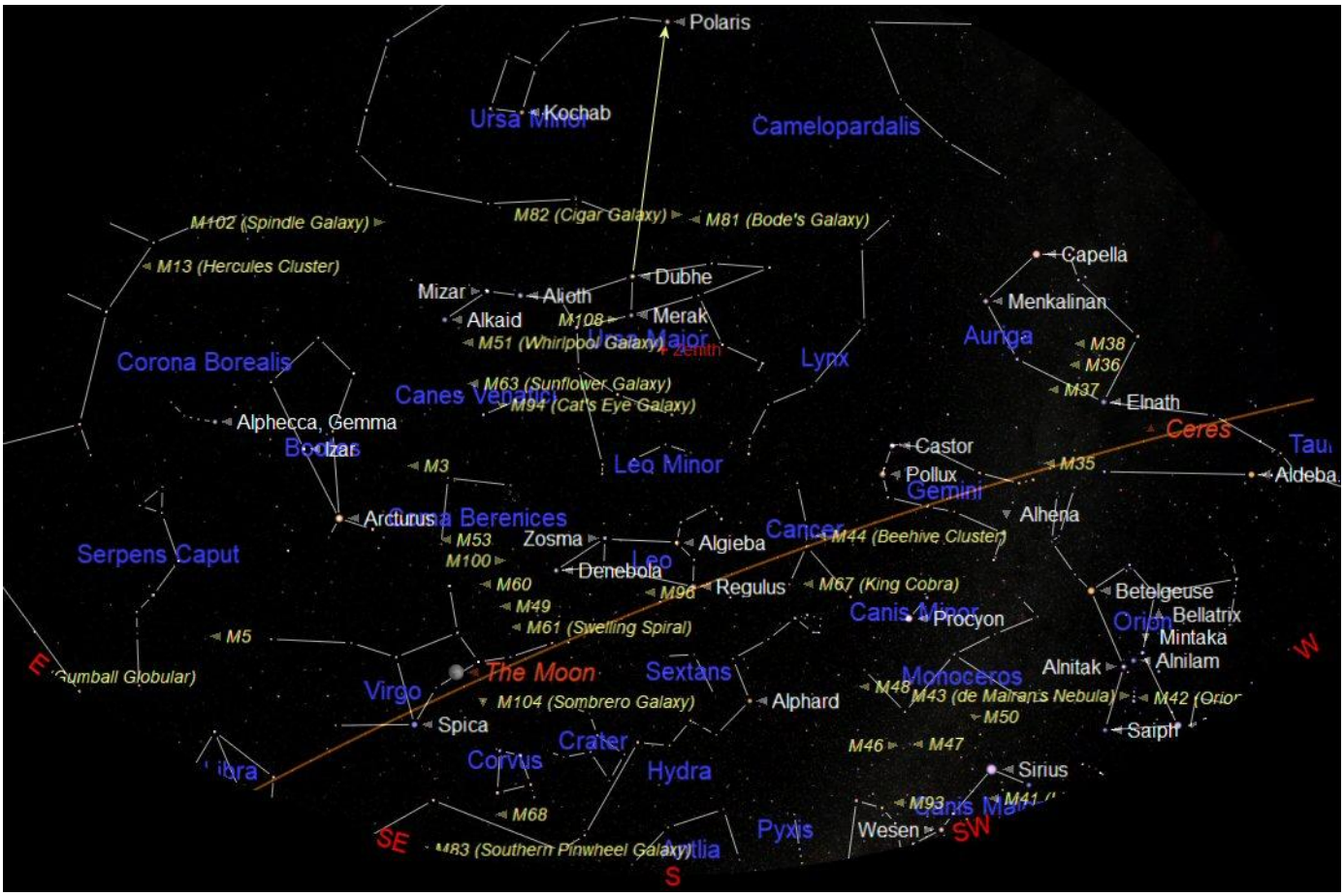
As the Universe continued to expand, gravity pulled the atoms together and formed vast filaments across the whole Universe. As the gas was drawn closer together stars and galaxies formed in this gigantic web of filaments with huge empty voids between the filaments.



A computer generated image of the filament structure

The filaments closest to us have now been mapped by the Slone Digital Survey and look very much like the CGI above. Some of the filament structure in our local area can be seen on the chart at the top of this page.

A TOUR OF THE NIGHT SKY - APRIL 2022



The chart above shows the night sky looking south at about 22:00 BST on 15th April. 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: Pisces (the Fishes) just off the right of the chart, Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion), Virgo (the Virgin) and Libra (the Scales) just coming into view.

In the early evening southern sky is 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.

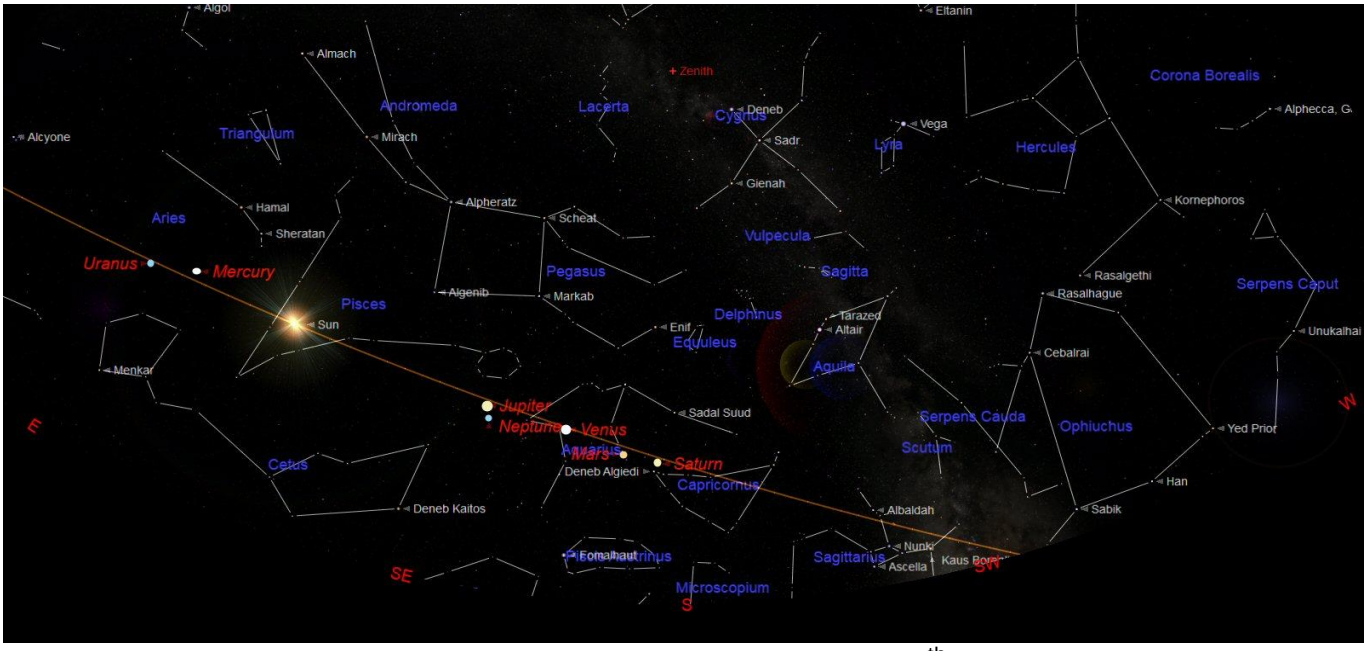
To the south of Taurus is the winter constellation of Orion (the Hunter) that dominates the southern night sky. Orion is easily found by looking for the very obvious three stars of his belt. As he is so easy to find it is a good place to start exploring the sky. Orion has his Hunting Dogs Sirius (the 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 (left) 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 constellations of Coma Berenices and 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, see pages 3 to 7. A medium sized telescope (150mm to 200mm) and a dark sky is required to see these faint objects.

The constellation of Virgo (the Virgin) can be seen at the lower east (left) of the chart above. To the north (above) and between Virgo and Leo is the fainter constellation of Coma Berenices (the hair of Berenices).

THE SOLAR SYSTEM - APRIL 2022

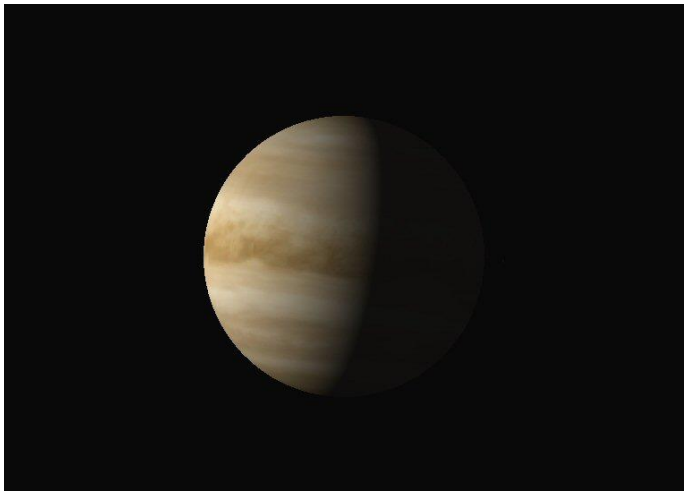


The location of the planets at 09:00 BST on 15th April 2022

The chart above shows the location of the planets along the Ecliptic in the morning sky. The sky has been darkened to make the planets visible. The planets are: (in order as they appear before sunrise) Saturn, Mars, Venus Neptune and Jupiter. They are visible along the Elliptic from the West (right) to East (left). Mercury and Uranus appear close to Sun after it sets over the western horizon in the evening. The planets appear low in the sky, in the bright morning or evening sky so are not well positioned for observing.

MERCURY will be in superior conjunction with the Sun on 2nd April. After conjunction it will be moving into the evening sky and setting soon after the Sun. Mercury will reach its greatest elongation on 29th April when it will be at its apparent furthest point from the Sun.

VENUS rises about one hour before the Sun climbs over the eastern horizon. It is looking very bright in the east before sunrise. It will show a large diameter but it will be getting smaller and will appear as a widening crescent. It is called the 'Morning Star' at this time.



Venus as it will appear on 15th April

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 has moved away from the Sun after its conjunction on 5th March. It is now briefly observable low over the eastern horizon before sunrise.

SATURN has now moved away from the Sun after its conjunction on 4th February so will be appearing in the morning sky about two hours before sunrise. It will be very low over the eastern horizon in the brightening sky but will be moving into the evening sky later in the year.

URANUS will be observable this month in the early evening sky when it will be in the south east and at its highest point above the horizon but it is small and faint at +5.9 so will need a telescope to see well.

NEPTUNE was in conjunction with the Sun on 13th March and has moved into the early morning sky. It is quite easy to find this month because it is located close to the much brighter Jupiter. It will still be difficult to see in the brightening dawn sky and will need a telescope.

THE SUN

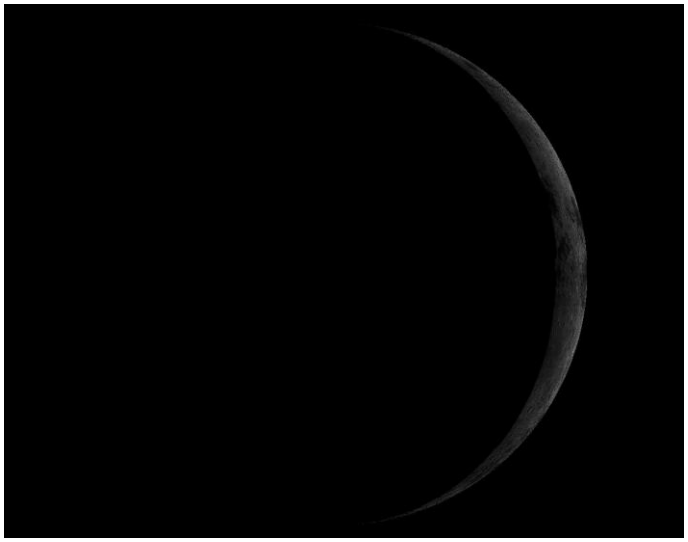
The Sun rises at about 06:40 BST at the beginning of the month and 05:50 by the end of the month. It sets at 17:45 at the beginning of the month and 18:30 at the end of the month. It will be half way to midsummer on 20th March when it will be the spring (Vernal) equinox. On this date the night and day will be of equal length and exactly 12 hours long.

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. The Sun is starting to climb higher in the sky now. It will be half way between its lowest point (Winter Solstice) on 21st December 2021 and its highest on 21st June 2022 (Summer Solstice).

There have been a few nice Sunspots recently. Sunspots and other activity on the Sun can be followed live and day to day by visiting the SOHO website at: http://sohowww.nascom.nasa.gov/.

THE MOON PHASES DURING MARCH

As the Moon moves away from its conjunction (alignment) with the Sun it appears to move eastwards when viewed from the surface of Earth. It appears to move from west to east (to the left) about 12° each day. Therefore one day after conjunction with the Sun the Moon will have moved 12° east of the Sun. The New Moon would normally not be visible until at least the 2nd evening after conjunction with the Sun. This is because the Moon is too close to the Sun and the sky is too bright.



The New Moon might be seen on 3rd April in the west

As the Moon continues from west to east around its orbit, more of the illuminated (day) side is revealed and appears as a wider 'Crescent' shape. When the Moon has reached approximately a quarter of its orbit, in 7 days, it will appear as the 'Half Moon' or 'First Quarter'. The Half Moon is always located in the south as the Sun is setting in the west.

First Quarter will be seen on 9th March

After the first quarter, the 'Waxing' (widening) crescent shape gives way to the shape known as the 'Waxing Gibbous' phase. After 14 days the Moon is positioned directly opposite to the Sun and the whole of the sunlit side is visible so we see the 'Full Moon'. The Full Moon will rise in the east as the Sun sets in the west. As the Moon continues its orbit, the dark half of the Moon begins to appear and the sunlit side moves out of view in its 'Waning (narrowing) Gibbous' phase.

Full Moon will be rising in the east on 16th April

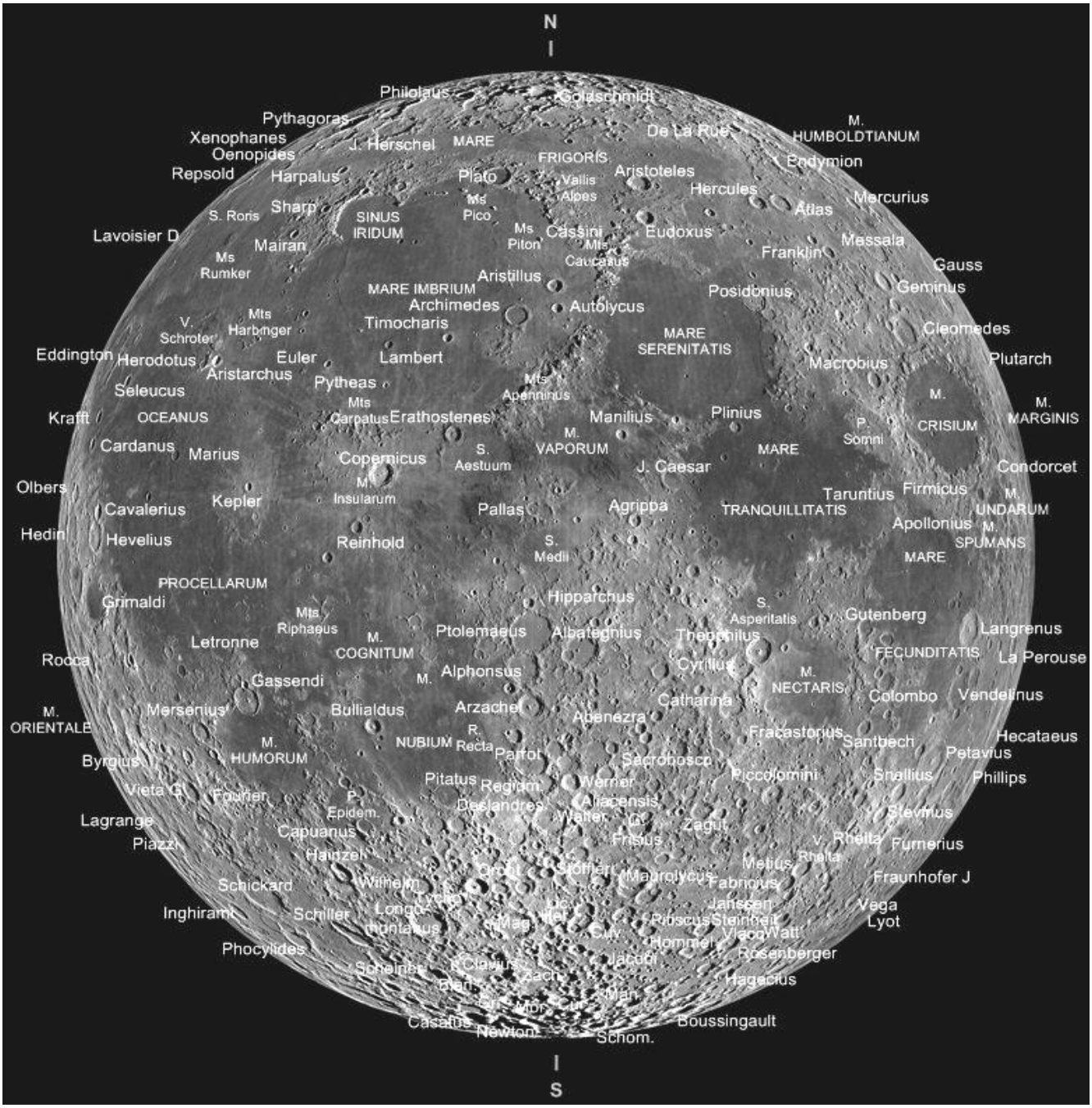
After 21 days, only half of the Moon appears illuminated and is called the 'Last Quarter' (the opposite side to First Quarter). The final phase is the 'Waning Crescent' as less of the sunlit side is visible from Earth. Finally after ~29 days the Moon moves into direct line with the Sun and the next New Moon begins.

The Last Quarter Moon will be on 23rd April

The Last Quarter Moon will not be visible in the evening sky because it is on the day time side of Earth. The Moon will not rise over the eastern horizon until about six hours after sunset so this will be at about 2 o'clock in the morning. This means the Last Quarter Moon will still be visible in the south east in the dawn sky.

The final phase is the 'Waning Crescent' as less and less of the sunlit side of the Moon is visible from Earth. Finally after ~29 days the Moon moves back into direct line (conjunction) with the Sun and none of the sunlit side is visible. There will be a second New Moon on 30th April but the crescent will not be visible until 2nd May. The New Moon would normally not be visible until the 2nd or 3rd day after conjunction with the Sun. This is because the Moon is too close to the setting Sun in the west and the sky is too bright.

FEATURES ON THE MOON



A map of the Moon with Maria (Seas) and Craters labelled

With our unaided (naked) eyes we can see darker patches on the surface of the Moon. These are called 'Maria' (Mare single) the Latin word for Sea because originally they were mistakenly thought to be seas on the Moon. The Maria are particularly obvious on the Full Moon and are marked on the map above as Mare Serenitatis (Sea of Serenity) for example. Using binoculars will show the shapes of the Maria in more detail and also reveal the smaller dark areas that may be parts of larger seas or separate areas.

A telescope will reveal the Moon in a completely different view. Probably the most noticeable feature will be the thousands of large and small craters. It is interesting to distinguish the different types of craters and how they appear. Some large craters have a central mountain and often have terraced walls. Some have smaller craters inside their walls that help to work out the sequence of how they were formed.

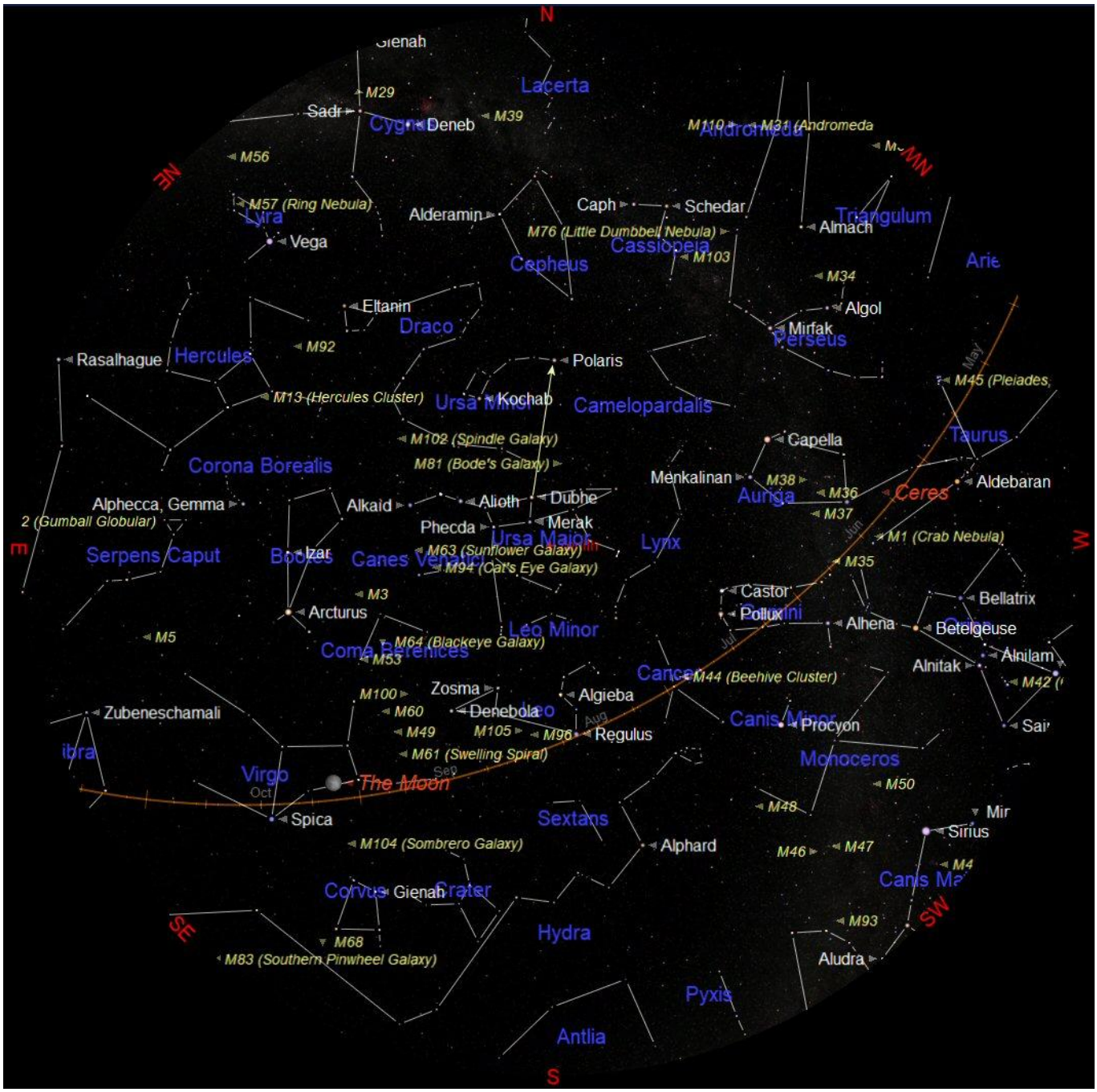
Some areas of the Moon are more cratered than others. There are large areas that have so many craters that there appear to be no smooth areas at all. Other areas, particularly Maria, have almost no craters.

There are also mountain ranges that are often named after mountain ranges on Earth. Most of these mountain ranges appear to be the walls of vast craters that have all but disappeared under ancient lava flows and the effect of later impacts. There are however some that do appear to be natural mountain ranges.

There are features known as 'Rills' that appear to be gullies and creases or cliff faces caused by cracking of the surface as the Moon cooled billions of years ago.

Craters, Mountains and rills are best viewed when they are close to the 'Terminator', the line between night and day. Here the shadows cast by the setting Sun cause long shadows that give relief and clarity to the view.

THE NIGHT SKY – APRIL 2022



The chart above shows the whole night sky as it appears on 15th April at 21:00 (9 o'clock) British Summer Time (BST). 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 BST at the beginning of the month and at 10 o'clock BST 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 located almost directly overhead. 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.

Mercury and Uranus are visible in the early evening sky this month.