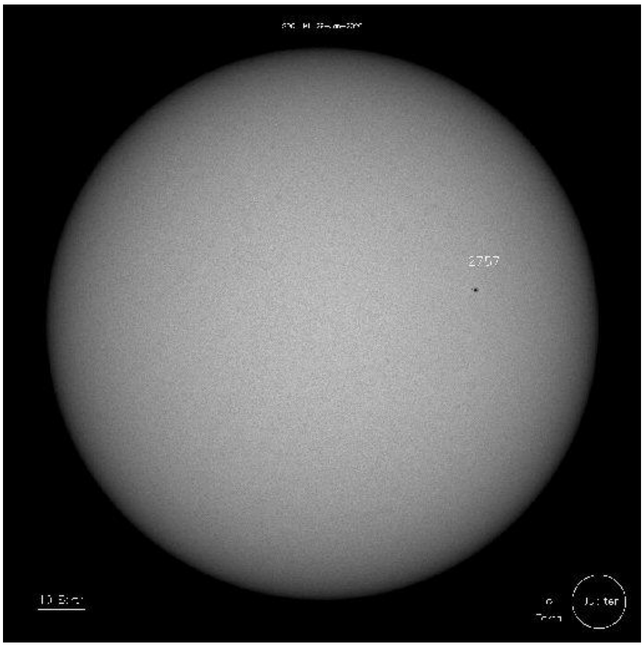
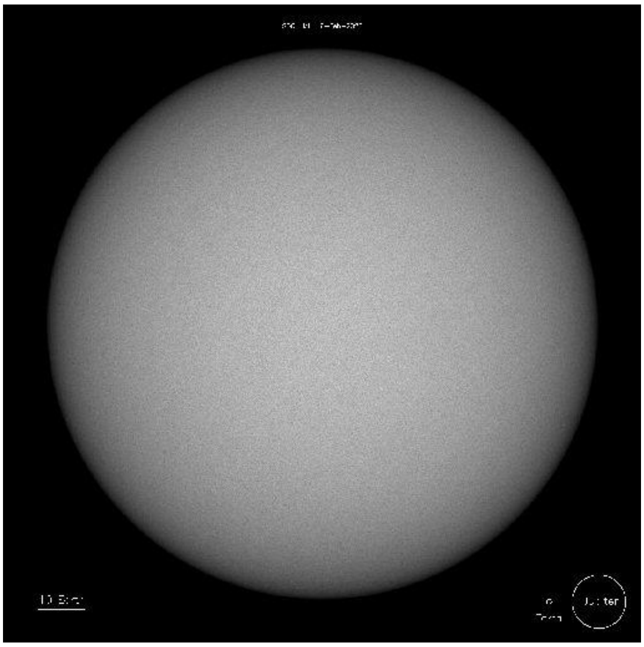
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – MARCH 2020

OUR SUN IS VERY QUIET AT THE MOMENT



The Sun imaged 29 January 2020



The Sun imaged 16 February 2020

Our star 'the Sun' has an eleven year cycle when Sunspots appear regularly and then become less common, known as maximum or minimum. We are currently in a minimum of sunspot activity phase which normally lasts about five years. However there have been very few sunspots in this current 'minimum'. In fact only a couple have been seen over last year or two. The most recent was a small one at the end of January (see the image above).

Many amateur astronomers are interested is Solar Observation as well as being interested in observing the night sky. Solar observing can be done using very basic equipment but can be expanded into areas of study that can be more expensive.

At the entry level no equipment is necessary. Daily images of the Sun can be downloaded from NASA's Solar Heliographic Observatory (SOHO) from the website: https://sohowww.nascom.nasa.gov/sunspots/. These are images taken at different wavelengths of light that show Solar activity in great detail as shown by the images above.

It is interesting to make our own observations using our own equipment. The simplest equipment can be binoculars or a modest telescope. We must never look directly at the Sun but we can project the image of the Sun on to a piece of card and look at that image safely.

The next step in sophistication is to make a mount for the card rather than trying to hold it behind the eyepiece. This can be done by making a small frame from wood or cardboard. This can be a simple task but does give a much steadier image and is a lot easier to use. Having the binocular or telescope on the same mounting as the card makes it very easy to use.

Moving up to the next level would be to fit a filter to a basic telescope to enable direct observing of the Sun through the telescope. This is not difficult to do because ready-made solar filters can be purchased from astronomy shops at a reasonable price. They can also be made quite simply using a sheet of filter film that can be purchased in A4 sheets for about £22, NEVER USE UNAPPROVED FILM SHEETS.

A telescope fitted with a Solar Filter can be used like a normal telescope to look directly at the Sun. This gives a much better view of the Sun than the image projected on to a card. A Solar Filter also has the advantage that different eyepieces can be used to increase the magnification to obtain a closer view.

A normal film solar filter will prevent most of the sunlight entering the telescope and causing damage to the eye. All wavelengths of sunlight can pass through the filter but the intensity is greatly reduced to a safe level. So we achieve a view of the Sun that appears as if we could look directly and unfiltered at the Sun.

Special filters known as Hydrogen α (alpha) filters that only allow a discrete wavelength of light to pass through can be fitted. These allow great detail of the surface of the Sun to be seen. However these are expensive but brilliant to use.

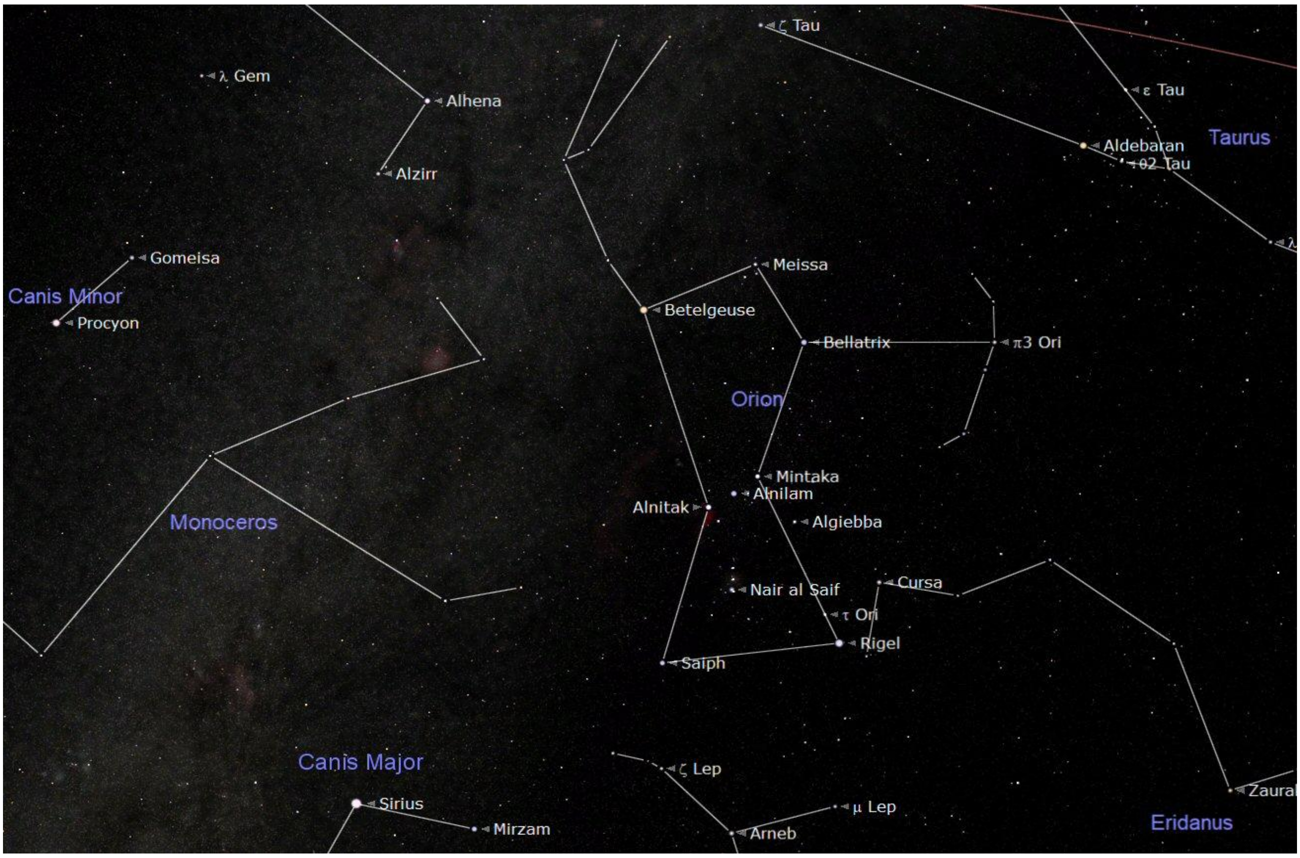
NEWBURY ASTRONOMICAL SOCIETY MEETING

6th March — Mexican Large Millimeter Telescope
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

18th March — The Messier Half Marathon
Website: **www.naasbeginners.co.uk**

WHAT IS HAPPENING TO BETELGEUSE?



The constellation of Orion (the Hunter)

At this time of the year amateur astronomers are enjoying the magnificent sight of the constellation of Orion (the Hunter) as it dominates the southern sky. This year we have another reason for visiting Orion, something strange is happening to the beautiful Red Giant Star called Betelgeuse.

A quick word about measuring star brightness.

We measure the brightness of a star by magnitudes. Without going into this too deeply, this means a change in Magnitude of 1 represents a change in brightness of a star by about 2½ times. The brighter the star appears the lower the Magnitude number will be. For example a Mag. +6.0 is 5 times (2x(2.5)) fainter than a Mag. +3.0 star, a Mag. +2.0 star is 5 times fainter than a 0.0 star and a Mag. 0.0 star is 5 times fainter than a Mag. -2.0 star.

Betelgeuse is the bright orange looking star located at the Hunter's left shoulder, as we look at him. This star normally has an apparent magnitude of about +0.45 but is naturally variable between 0.0 and +1.6. Interestingly it has faded noticeable over the last few months and is now close to +2.0 and still fading. This is much fainter than its normal minimum of variability at +1.6.

To put this change in brightness into context, the star Bellatrix at Orion's opposite shoulder has a magnitude of +1.62 so it is normally fainter than Betelgeuse even at its faintest (+1.6). At the time of writing this article Betelgeuse appears fainter than Bellatrix to the naked eye. This is not a perfect comparison because of the colour difference but it is noticeable that Betelgese is definitely fainter than Bellatrix. This is despite Bellatrix always being fainter than Betelguese so what we are seeing is unusual to say the least.

Betelgeuse is a Red Giant Star and is in fact the largest (in diameter) of all the stars in our vicinity. Its diameter is equal to the orbit of Jupiter around our Sun. It is a star that is approaching the end of its life and has become inflated and quite unstable.

It always was a giant star, 11.6 times the mass of our Sun. Being so large it used its Hydrogen fuel supply up at a frantic rate and its core filled with the Helium produced in the Fusion process. As a giant star it was then able to fuse the Helium into Carbon and Oxygen. The fusion process was then able to fuse the Carbon into Neon, Magnesium, Sodium Aluminium and eventually Silicon. All these additional fusion processes provided additional energy to the star to push out against its gravity and caused the star to expand in diameter.

Betelgeuse has nearly reached the end of this process and will, at some time, begin to produce Iron in its core. At this point things will start to happen very quickly as the core fills rapidly with Iron. The Iron fusion process consumes energy and does not produce energy during its production. The star will become very unstable and suddenly collapse. The collapse will cause a catastrophic Supernova explosion that will destroy the star.

There is some speculation that we may be witnessing the final days of Betelgeuse but this is nowhere near certain. It may be just an extreme minimum in its normal variability cycle. Alternately it may just be suffering a star's equivalent of indigestion and could puff off some of its mass into space.

Whatever is happening we need to keep a close watch on Betelgeuse just in case we do miss the Supernova.

THE LARGE SCALE STRUCTURE OF THE UNIVERSE

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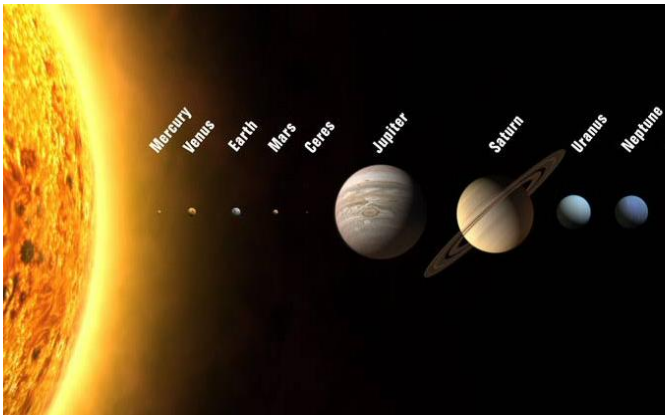
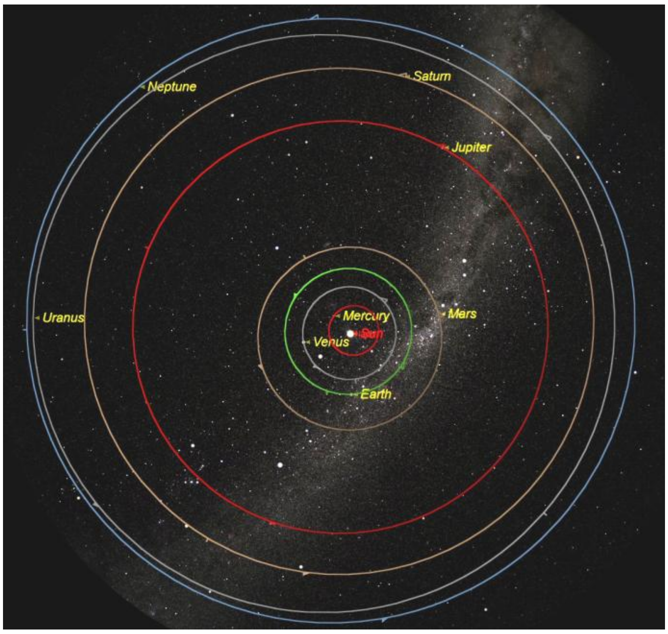
Our location Newbury, England

The starting point for our journey through the Universe is our home on the planet Earth. The arrow on the image above shows the location of our Newbury Astronomical Society Beginners Meeting in Newbury, Berkshire in England.



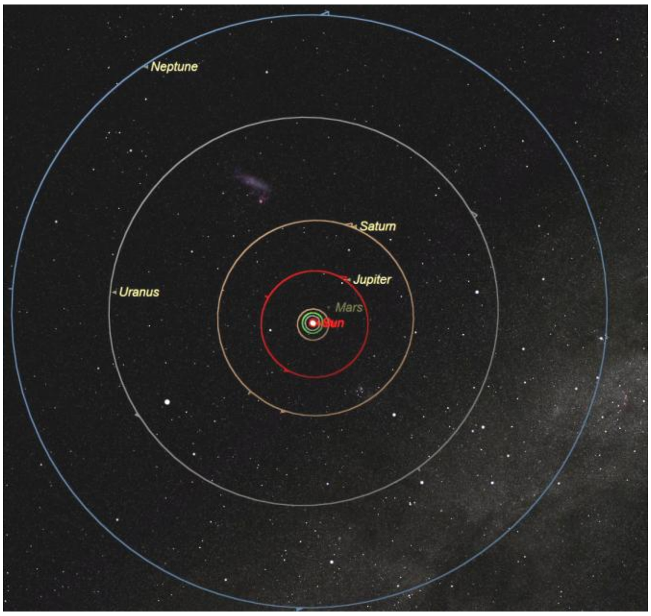
Our location in the Solar System

Our Planet is the third of the eight main planets that orbit our star that we call ‘the Sun’. Our Sun is a normal small star that is about half way through its life (about 4.3 billion years of its expected lifetime of 9 to 10 billion years).



The inner planets of our Solar System

The chart at the bottom of the previous column shows the inner Solar System with the inner planets, Mercury, Venus, Earth and Mars in their relative positions compared to Earth on the evening of the February 2020 Beginners Meeting. The much larger orbits of the outer planets have been compressed to allow all the planets to be included.



The Outer Planets of our Solar System

The chart above shows the whole Solar System with the smaller orbits of the four inner planets, Mercury, Venus, Earth and Mars in the centre. The orbits of the outer planets are shown as their relative size compared to the much smaller orbits of the inner planets. This chart shows the orbits of the outer planets Jupiter, Saturn, Uranus and Neptune in their relative positions to Earth last month.

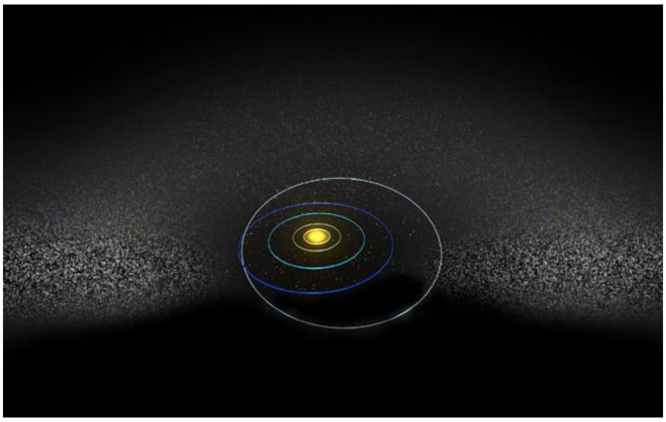


Chart showing the Kuiper Belt

Beyond the outermost planet, Neptune, is a vast cloud of minor planets that we call ‘the Kuiper Belt’. This is a toroidal (doughnut shaped) ring of Dwarf Planets composed mainly of water ice. These range in size from the size of Pluto to boulder sized lumps and there are millions of them. Pluto is considered to be one of these Dwarf Planets but is the closest and one of the largest of these bodies that we call Kuiper Belt Objects. Although there are millions they are spread over such a large area they mostly hundreds to thousands of kilometres apart. (As Pluto is now considered to be Dwarf Planet it is shown as the outer white orbit.)

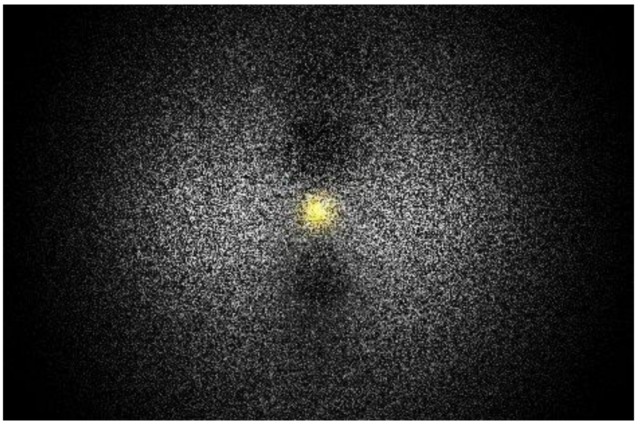


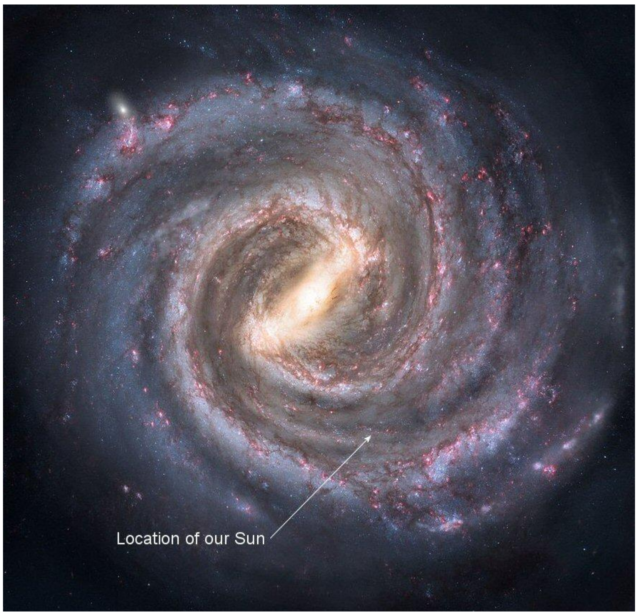
Chart showing what the Oort Cloud might look like

Beyond the Kuiper Belt there is thought to be a vast halo of icy bodies that surround the Sun out to the very edge of its gravitational influence this area is called the Oort Cloud.

These are believed to be similar to the members of the Kuiper Belt but much further from the Sun. They are thought to have orbits that may be up to 2 light years and possibly 2.5 light years from the Sun. This means that the outer orbits may reach more than half way to our nearest star system, known as Alpha Centuri that is about 4.3 light years away. So the outermost Oort Cloud members may be exchanged with Alpha Centuri Oort Cloud members, if there is one and it is very likely that there is.

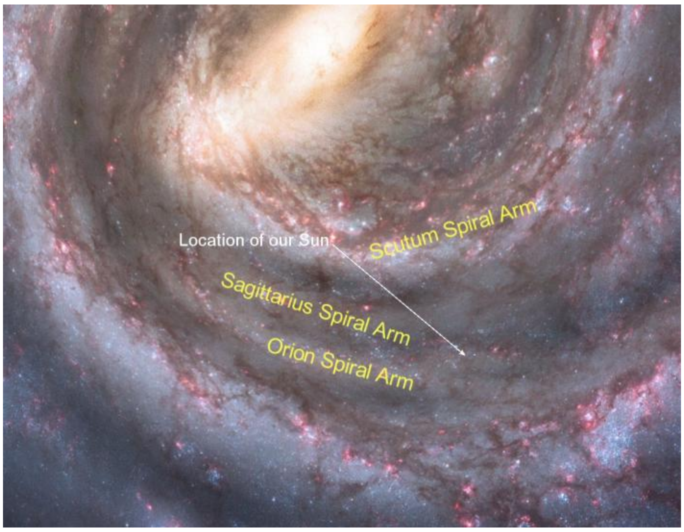
THE REALM OF THE GALAXIES

When we look out into the night sky using just our unaided eyes we can see many stars. Other than the other members of our Solar System, that is all we can see in the northern hemisphere. In the southern hemisphere we can see two fuzzy' objects that we call the Magellanic Clouds (more about them later).



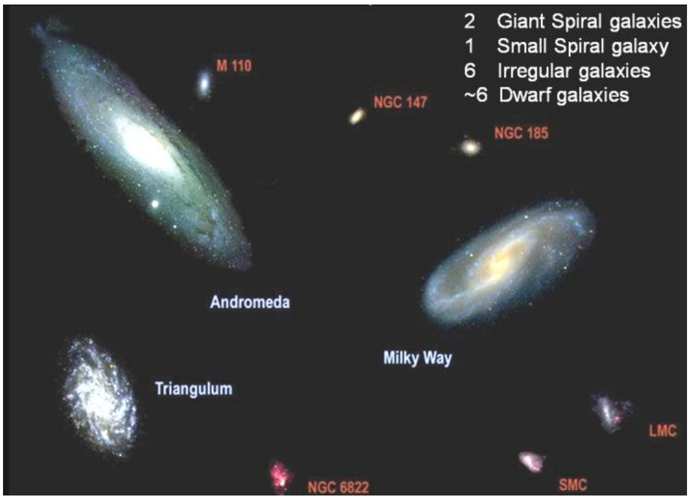
An artist's impression of our Milky Way Galaxy

Our Sun is a member of a giant spiral Galaxy that we call the Milky Way Galaxy. Our Sun is one of about 200 billion stars in this giant galaxy. Our Galaxy has its spiral arms attached to a central bar so the Milky Way is classified as a Giant Barred Spiral Galaxy. The Milky Way is about 100,000 light years across from edge to edge.



A closer view of our place in the Milky Way

Our Sun is located on the outer edge of the Sagittarius Spiral Arm. So when we look towards the constellation of Sagittarius we are looking to the centre of our Galaxy. When we look towards the constellation of Orion we are looking towards the outer edge of our Galaxy in the direction of the Orion Spiral Arm. The Sun is about 30,000 light years from the centre and about 20,000 light years from the outer edge.



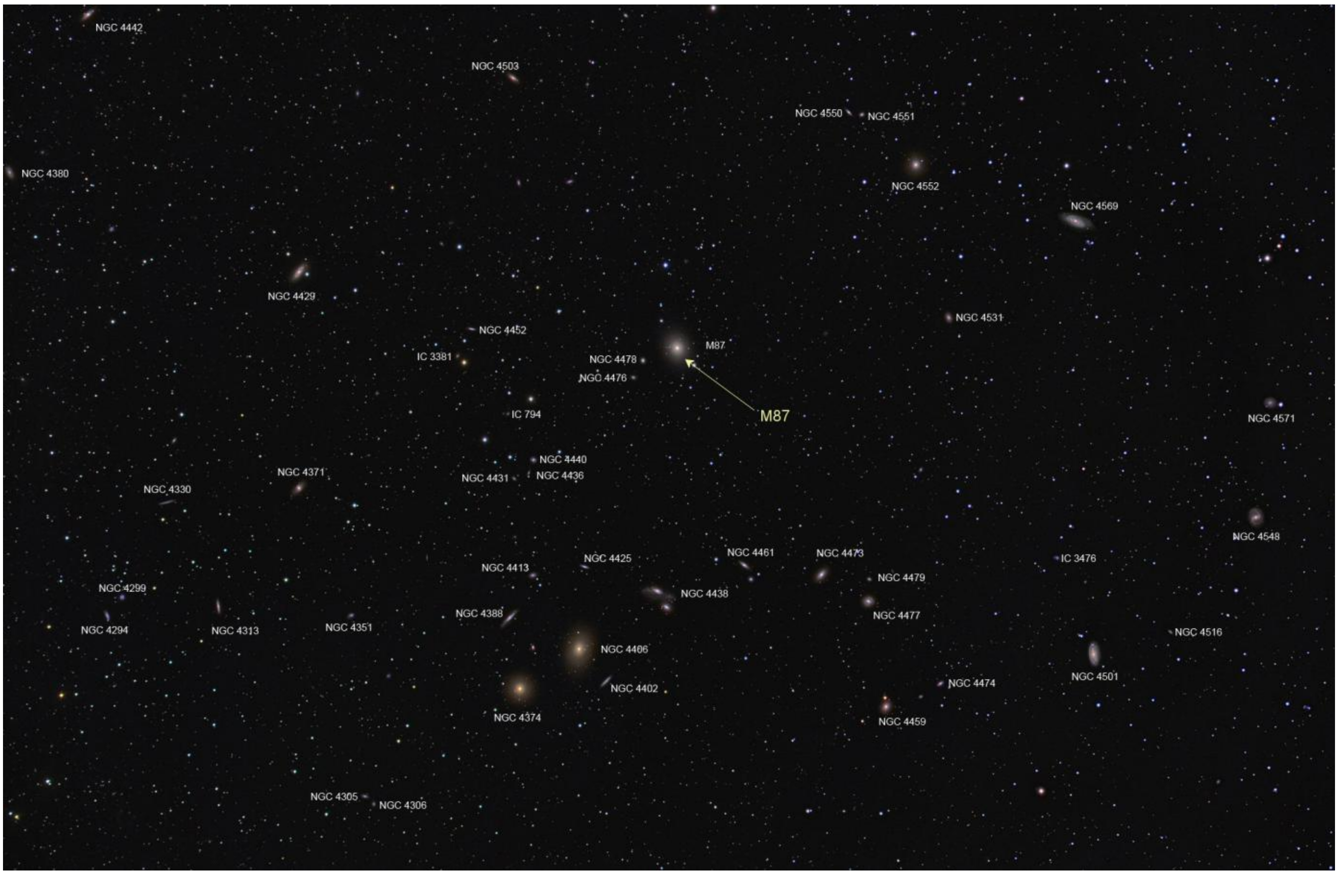
Our Local Group of Galaxies

Our Milky Way Galaxy is in a small group comprised of two Giant Spiral Galaxies, one smaller Spiral Galaxy, six Irregular Galaxies and about six Dwarf Galaxies. These make up our 'Local Group' of fifteen closest galaxies. The galaxies in the lower right corner of the diagram above, marked LMC and SMC, are small Irregular Galaxies. They are satellite galaxies gravitationally attached to our Giant Spiral Galaxy. They are called the Large and Small Magellanic Clouds and can easily be seen in the night sky from the southern hemisphere.

There are six (identified) Dwarf Galaxies in our Local Group that look like clusters of up to a million stars.

All the galaxies in our Local Group are gravitationally linked to each other. It is thought that the smaller Galaxies will eventually be pulled into the two Giant Spiral Galaxies and consumed.

The two Giant Spiral Galaxies are currently 2.3 billion light years apart but are being pulled towards each other and will merge into one larger Elliptical Galaxy in about five billion years time.



The Virgo Cluster of Galaxies

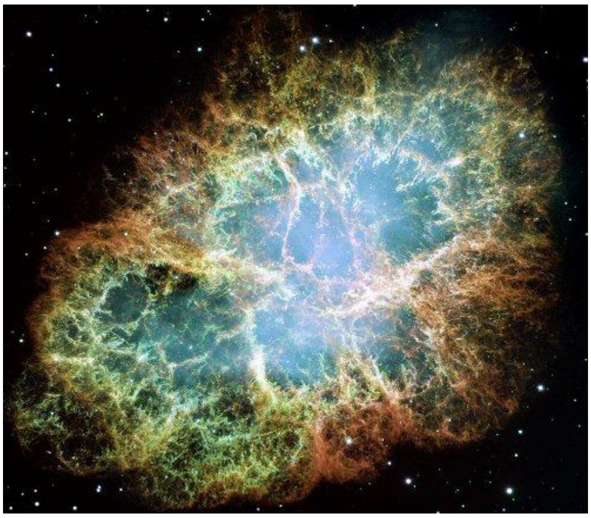
Our Local Group of galaxies are part of a much bigger cluster of galaxies called the Virgo Cluster (see the image above). Although this cluster of galaxies is called the Virgo Cluster it does overlap into the neighbouring constellations of Coma Berenices and Leo (See page 8). All stars at these vast distances are within the galaxies with a very few exceptions of stars that been thrown out of their galaxy. So in the vastness of the distant universe all we can see is galaxies.

Our Universe came into existence about 13.4 billion years ago. Somehow there was an unimaginably powerful release of energy that we call the Big Bang. This is not a good description because this occurred within a microscopic space that is called a ‘Singularity’. The Singularity had an infinitely small volume but an infinitely high mass, temperature and pressure.

The Singularity rapidly expanded as a spherical ball of very hot energy and continued to expand and started to cool. After a period of about 100,000 years the ball of energy had cooled sufficiently for atoms to form. The energy was converted to Mass (Hydrogen and Helium atoms with a small amount of Lithium) in accordance with Albert Einstein’s famous equation $E = Mc^2$. This is transposed as $M = E/c^2$. This means Mass (M) was created from the Energy (E) at a rate divided by the speed of light (c) squared (c^2). At this point a massive flash of electromagnetic radiation (in the form of Gamma and X-Rays) was released.

The spherical mass of atoms of Hydrogen (89%) and Helium (11%) cooled as it continued to expand. Gravity pulled the atoms together creating dense filaments and empty voids. Gravity in the filaments caused the gas to be compressed into huge dense clumps, within the filaments, that became galaxies and within the galaxies stars formed from the gas at a smaller scale.

The nearest example that we have of a very large explosion is the final moments of a giant star that was ten or more times the mass of our Sun. We can see the remains of these tremendous explosions in the sky and we call them a Supernova or Supernovae in plural. The best know is Messier 1 (M1) known as the Crab Nebula in the constellation of Taurus (the Bull).



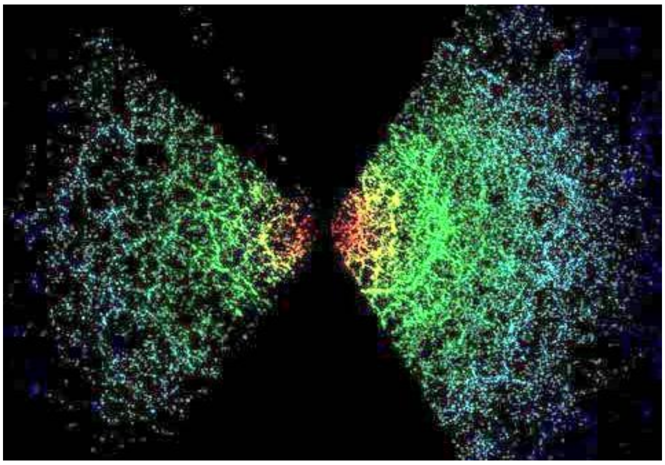
Messier 1 (M1) the Crab Nebula

A massive star that was just 6000 light years away from Earth exploded about 7000 years ago as a Supernova. It was seen and recorded as a very bright new star in the year 1054 AD. The Supernova was bright enough to be seen in daylight for about three months then faded. Its remnant can still be seen as a ‘fuzzy’ patch of light using a 150mm telescope. The filamentary structure and voids resulting from this tremendous explosion can be clearly seen in the Hubble Space Telescope image above.

We now have telescopes, cameras and instrumentation that enable us to map the universe around us. One of the first instruments to embark on this task was the Sloan Survey (deep space) Telescope. It is able to record details of thousands of galaxies in each image it produces. From these images a detailed map of the universe around us can be produced.

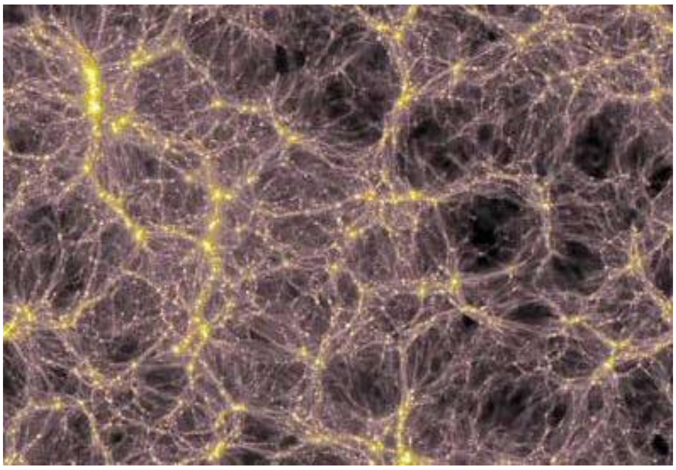
The Sloan Digital Sky Survey Telescope

The image below was produced from the data obtained by the Sloan Digital Sky Survey Telescope. It does, as predicted by computer calculations, show a structure of filaments and voids.



The image produced by the Sloan Telescope

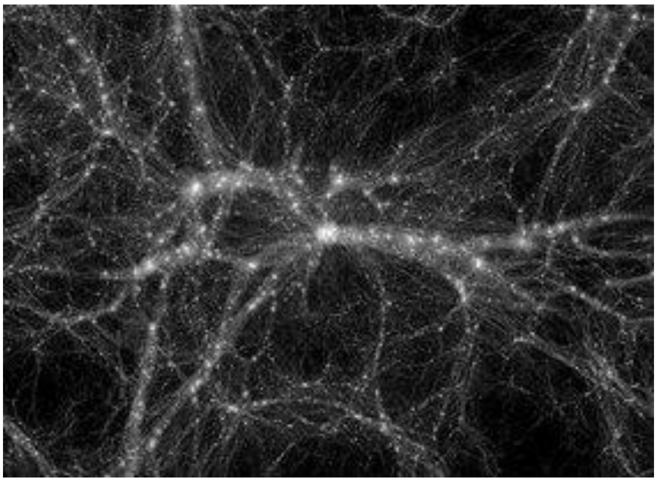
This structure is on a vast scale that our minds can find difficult to comprehend. The filaments are not comprised of stars they are all comprised of millions of galaxies. Our view in this image is looking above and below our galaxy, the Milky Way. Our view to the sides is obscured by the gas and dust in our own galaxy.



The structure of the Universe predicted by computers

So the detailed computer generated image at the bottom of the previous column shows us what the large scale structure of the Universe looks like. Gravity has pulled the original gas from the Big Bang into vast dense filaments. This is where galaxies formed from the swirling mass of atoms of gas (mainly Hydrogen).

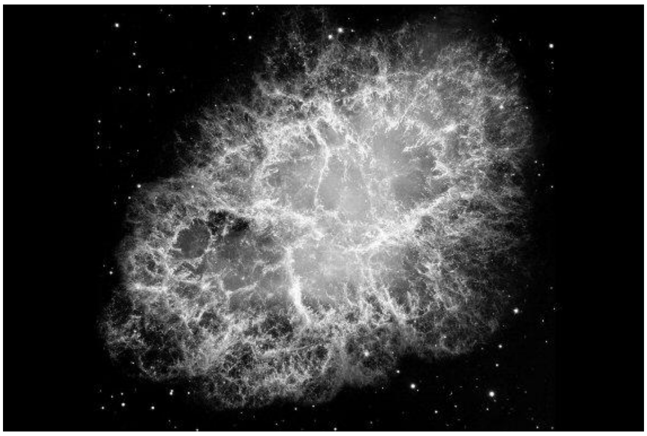
Within these galaxies individual stars like our Sun formed from the gas. As the gas was pulled into these filaments by gravity it left vast empty areas called Voids where there is almost no matter left.



A closer view of the CGI of filaments

If we look at these Filaments in more detail we can see the structure of the Universe closer to home. We can see bright spots in the filaments (called knots or Nodes) that are Super Clusters of Galaxies containing thousands of galaxies. Within the Super Clusters are smaller clusters like our own Virgo Cluster and within them are local groups like the fifteen galaxies that make up our Local Group.

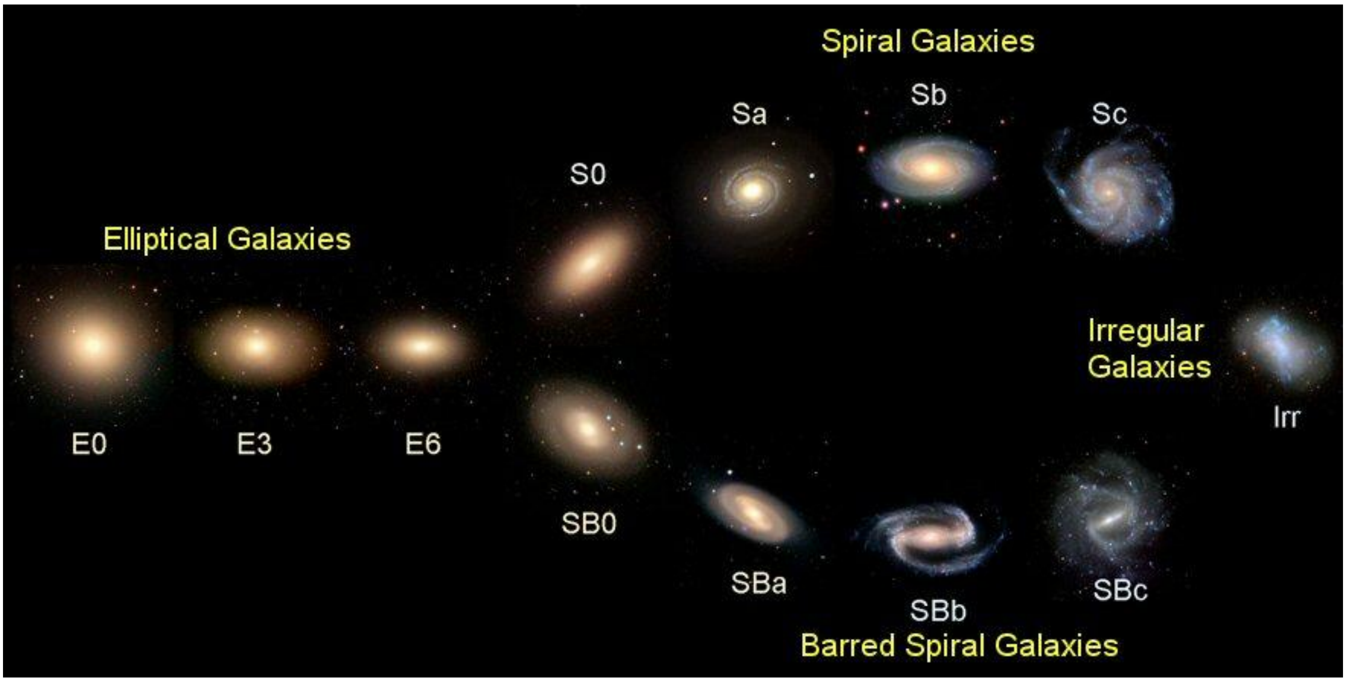
We can never see our Universe from the outside, it is simply too large to even contemplate such a view. So we can only speculate what the Universe might look like. However from what we know, indications are it might look something like the Crab Nebula but much more complex and unbelievably larger.



A supernova creates filaments and Voids

We do know the universe is comprised of ‘Filaments’ and ‘Voids’ from our computer simulations that are now ‘backed up’ by actual images of the Universe around our location. The Universe is most likely more spherical than the supernova remnant above and much more complex. We can only imagine what the overall shape of the Universe may look like.

THE DIFFERENT TYPES OF GALAXIES

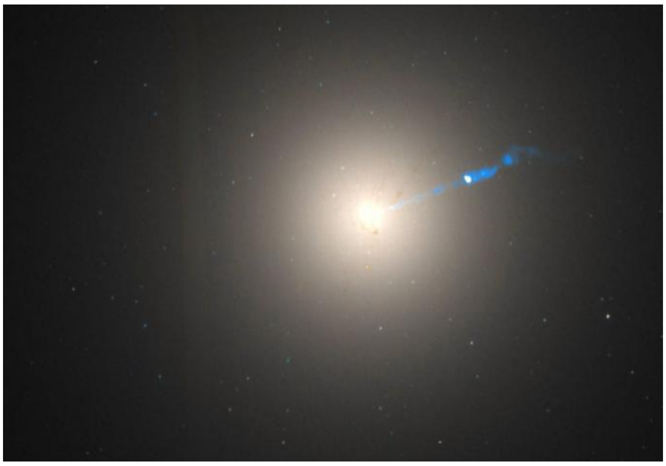


The Edwin Hubble (Tuning Fork) diagram of Galaxies

The diagram above is known as the 'Hubble Tuning Fork Galaxy Diagram' and was devised by Edwin Hubble to show the how galaxies develop. He initially thought Elliptical Galaxies developed spiral arms as they matured and became Spiral Galaxies.

As our understanding of galaxies increased it was realised that if galaxies were large enough they would form as spiral galaxies. Some Spiral galaxies develop a bar structure in the central core. The mechanism of the formation of the bar is not fully understood but it is probably a gravitational effect.

Giant Elliptical Galaxies are thought to be the result of the merging of Spiral Galaxies but some may have formed as Elliptical Galaxies. So if two or more spiral galaxies merged due to their gravitational attraction they may become a larger spiral or may become an Elliptical Galaxy. Generally Elliptical Galaxies are the largest and Spiral Galaxies can range from small up to giant in classification. Elliptical Galaxies are classified as E1 (spherical) to E7 (more flattened and elliptical).

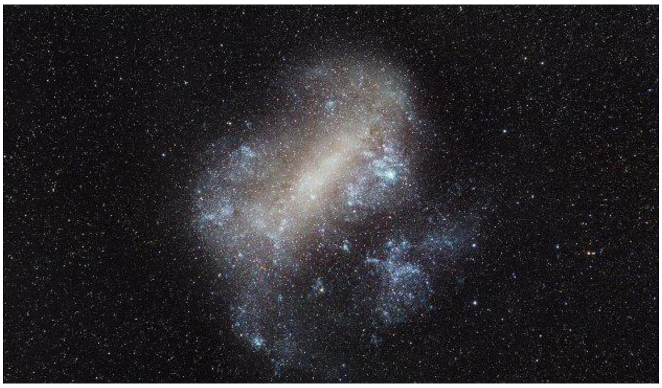


The Giant Elliptical Galaxy Messier 87 (M87)

Spiral Galaxies are classified S0 (partially formed arms) and Sa to Sc depending how developed and tightly wound the spiral arms are.

A Barred Spiral Galaxy

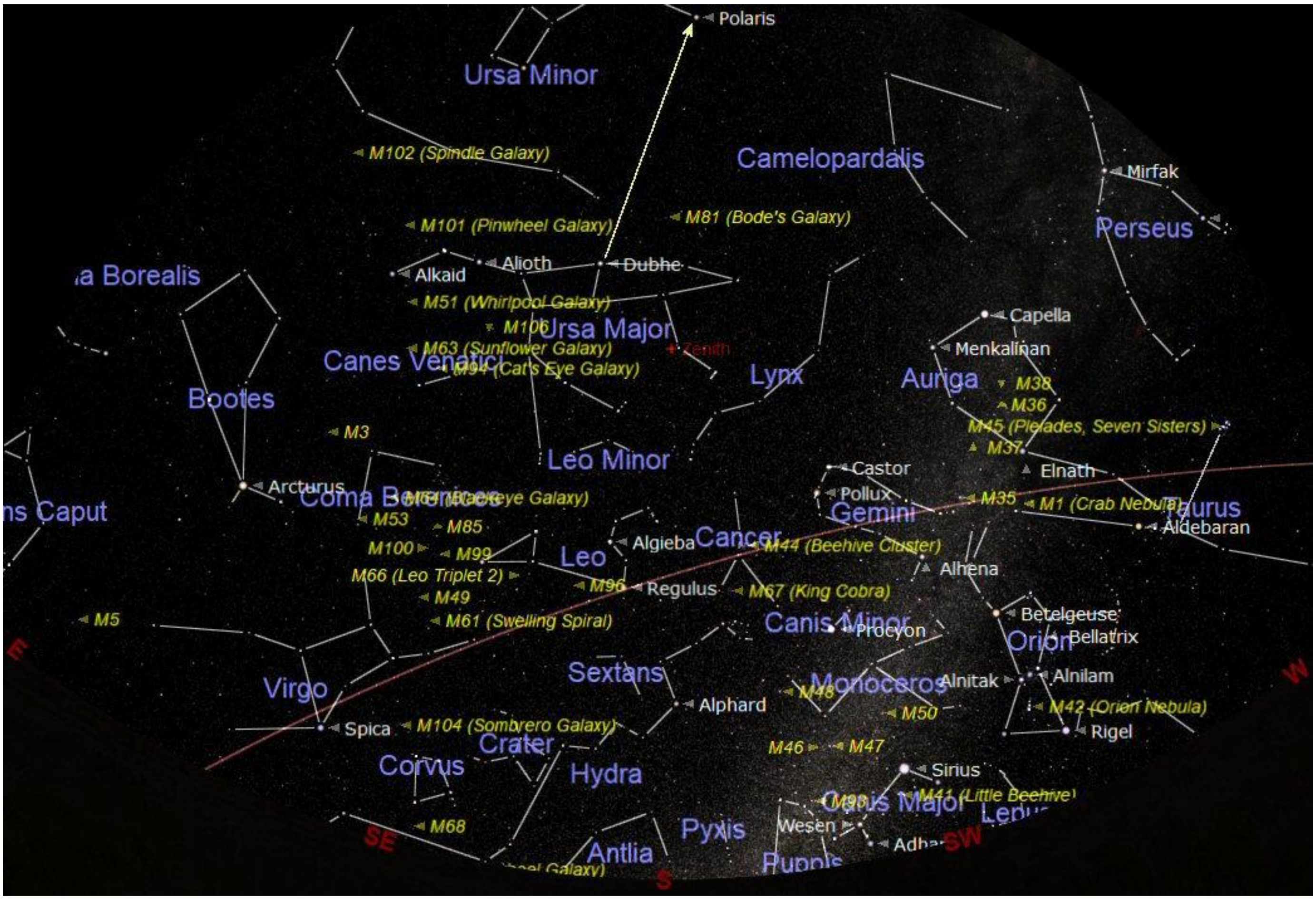
Barred Spiral Galaxies are classified SB0 and SBa to SBc similarly to plain spiral galaxies.



Irregular galaxies are a separate group that are too small to develop a recognised shape. Irregular Galaxies are normally too small to develop spiral arms but some (like the Large Magellanic Cloud) can show signs of the partial development of spiral arms.

There is another class of very small galaxy called Dwarf Galaxies. These resemble Open Clusters but their stars are old and gravitationally tied to the group that is stable. Open Clusters are young stars that have formed from a Nebula and will gradually disperse.

A TOUR OF THE NIGHT SKY - MARCH 2020



The chart above shows the night sky looking south at about 20:00 GMT on 15th March. 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), Aries (the Ram), Taurus (the Bull), Gemini (the Twins), Cancer (the Crab), Leo (the Lion), Virgo (the Virgin) and Libra (the Scales) rising over the eastern horizon.

Just disappearing over the south western horizon is the constellation of Pisces (the Fishes). The planet Uranus is in Pisces and can be found in the early evening using binoculars. Venus is shining very brightly in the constellation of Aries (the Ram). See page 9.

Still prominent in the south is the constellation of Taurus (the Bull). It sits on the Ecliptic and looks like a squashed cross 'X'. 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 Messier 45 (M45) known as the Pleiades (or the Seven Sisters). It really does look magnificent using binoculars.

Following Taurus along the Ecliptic is the constellation of Gemini (the Twins). The two brightest stars in Gemini are Castor and Pollux that are named after mythological twins and they are so alike they do look like twins. There are lines of fainter stars linked to Pollux and Castor and extending to the south west (down to the right). There is a lovely Open Cluster called Messier 35 (M35) just off the end and above the upper line of stars emanating from the star Castor. M35 will need a telescope to see well.

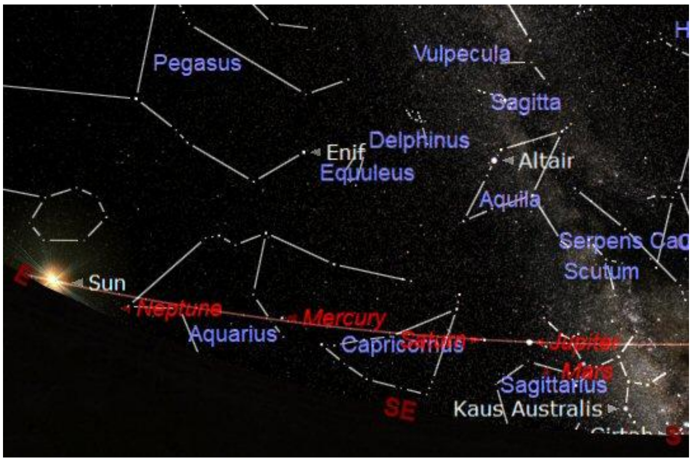
Following Taurus along the Ecliptic is the rather faint constellation of Cancer (the Crab). It does need a dark and unpolluted sky to see with the naked eye. In a good sky the faint stars can be seen with a nice Open Cluster of stars at its centre. The cluster is called Messier 44 (M44) or 'the Beehive Cluster' because of its resemblance to an old straw built beehive with a swarm of stars looking like bees around it. It looks best using binoculars.

Following Cancer along the Ecliptic is the constellation of Leo (the Lion). It does actually look a little like a resting male African lion but perhaps more like the Sphinx in Egypt. Below Leo are some relatively bright galaxies M65, M66, M95 and M96 but they do need a telescope to see them. The sky around Leo and particularly between Leo and Virgo hosts a cluster of nearby galaxies. Our Galaxy (the Milky Way) is actually a member of a small local group of galaxies that forms part of this larger cluster of galaxies.

To the south of Taurus and Gemini is the spectacular constellation of Orion (the Hunter). Orion dominates the southern sky and is one of the best known constellations. It also hosts some of the most interesting objects for us to seek out. See page 2 of this magazine.

THE SOLAR SYSTEM THIS MONTH (also see the next page)

MERCURY will just be observable this month but it will be very close to the horizon in the east before the Sun rises at 06:15. The innermost planet will be at Greatest Western Elongation (furthest position from the Sun) on 24th March, see the chart below. Mercury is small but quite bright although its brightness is rather overwhelmed by the brightness in the sky from the rising Sun. It is best seen using binoculars or telescope but we must make sure the Sun is below the horizon before sweeping the sky using binoculars to find Mercury.



Neptune, Mercury, Saturn, Jupiter and Mars at sunrise

VENUS has been moving out from behind the Sun and will reach Greatest Eastern Elongation (appearing furthest from the Sun on 24th March). See the gray orbit arc on the chart opposite. The fainter section (closer to the elliptic) shows the section that Venus has moved along and the brighter section is the part of its orbit it will be moving along during the next few months. Venus has looped out from behind the Sun is moving towards us. It will now appear to move back towards the Sun, following the brighter gray orbit arc. Venus will become a narrower crescent shape but will appear to become larger in diameter as it moves closer to us.

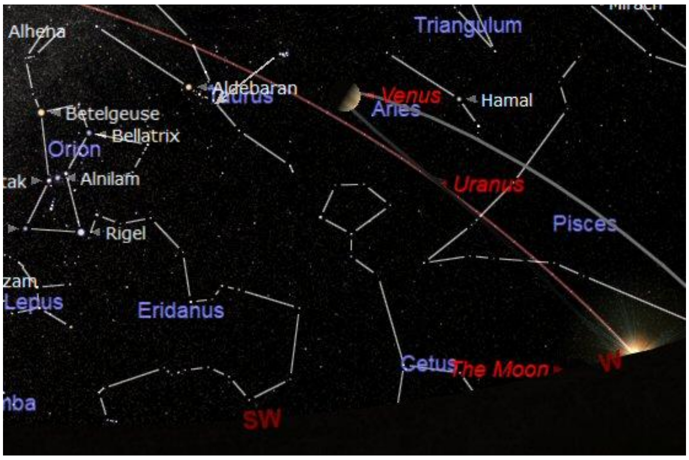
Venus how it will appear on 24th March

MARS will be observable (with difficulty) this month, low in the east before sunrise. Mars is still a long way from us on the other side of the Solar System so it looks small at just 5.9" (arc seconds). See the chart above.

JUPITER is moving away from the Sun in the early morning sky in the east. It will be very low in the sky and looking rather large but disappointing in the dirty and turbulent air close to the horizon. See the chart above.

SATURN will be low in the south east as the sky brightens before the Sun rises over the eastern horizon. Saturn is very low and in the murky and turbulent air close to the southern horizon. It will be in the bright dawn sky and will require a clear view to the eastern horizon. It may still just be possible to see the ring system although it will appear unstable due to the air movement close to the horizon. See the chart opposite.

URANUS will be visible in the early evening as a slightly fuzzy blue, star like, object, using a small telescope. A larger telescope with a magnification of 100x or more will show it as a small blue/green disc. See the chart below.



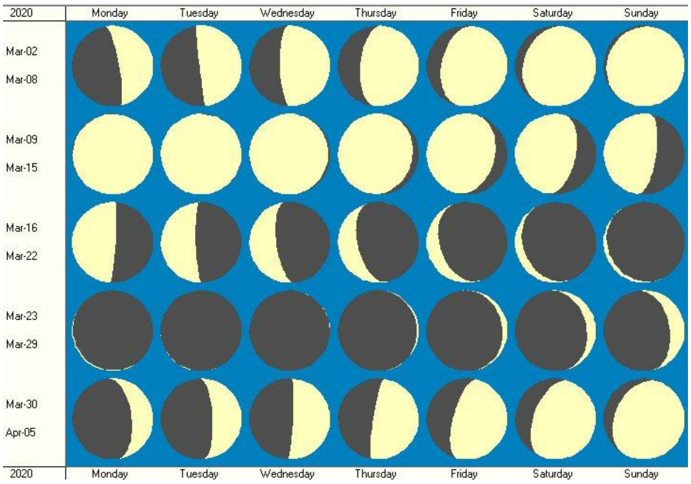
Uranus and Venus at Sunset on 24th March

NEPTUNE will be in conjunction with the Sun on 8th March appearing to pass behind the Sun. It will still be very close to the Sun after conjunction so will not be observable this month. See the chart opposite.

THE SUN

The Sun rises at 06:30 GMT at the beginning of the month and at 05:45 GMT by the end of the month. It will be setting at 17:45 GMT at the beginning and 18:25 GMT by the end of the month. 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 IN MARCH



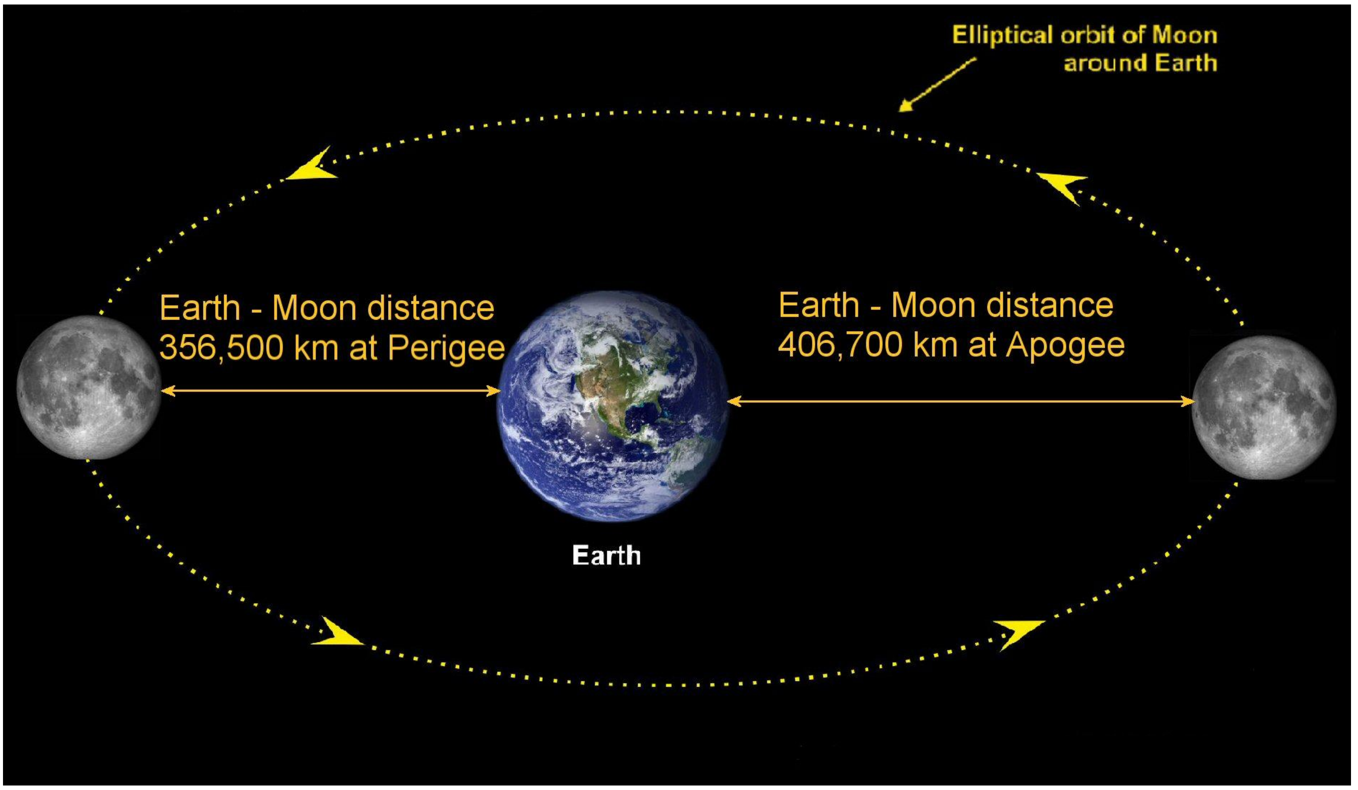
First Quarter will be on 2nd March

Full Moon will be on 9th March (see page 10)

Last Quarter will be on 16th March

New Moon will be on the 24th March

THE 'SUPER MOON' ON 9TH MARCH

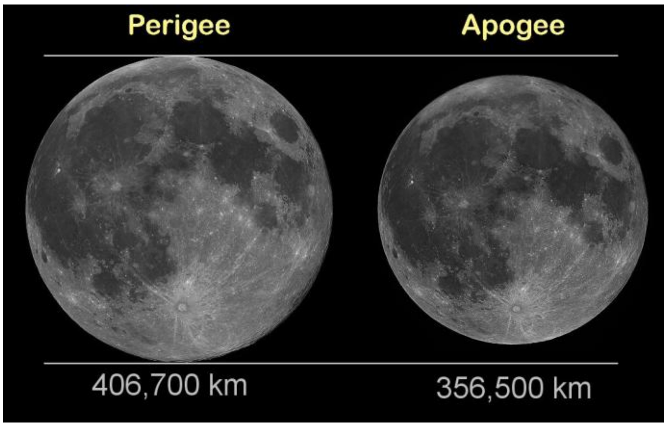


The Moon at Perigee (closest to Earth)

We hear a lot about the 'Super Moon' these days, mainly from the television news or in the popular news papers. So what does this mean and does it have any significance for astronomers?

The simple answer is no, it is of no scientific interest to astronomers but it is of general interest. There are two factors that produce the effect we call the Super Moon. One is a physical effect and the other is illusionary.

The first effect is to do with the orbit of the Moon around Earth. Like most orbiting bodies the orbit of the Moon is elliptical and not circular. This means the Moon will be closer to Earth at one point that we call 'Perigee' and furthest away at the point we call 'Apogee'. At Apogee the Moon can be up to 406,700 km away from Earth but at Perigee can be as close as only 356,500 km.



Comparison of size Perigee to Apogee

With this change in distance the Moon will actually look larger at Perigee (closest) and smaller at Apogee (furthest away). The difference in apparent diameter is up to 14% and the difference in the Moon's reflective area is about 30% so this does make a difference.

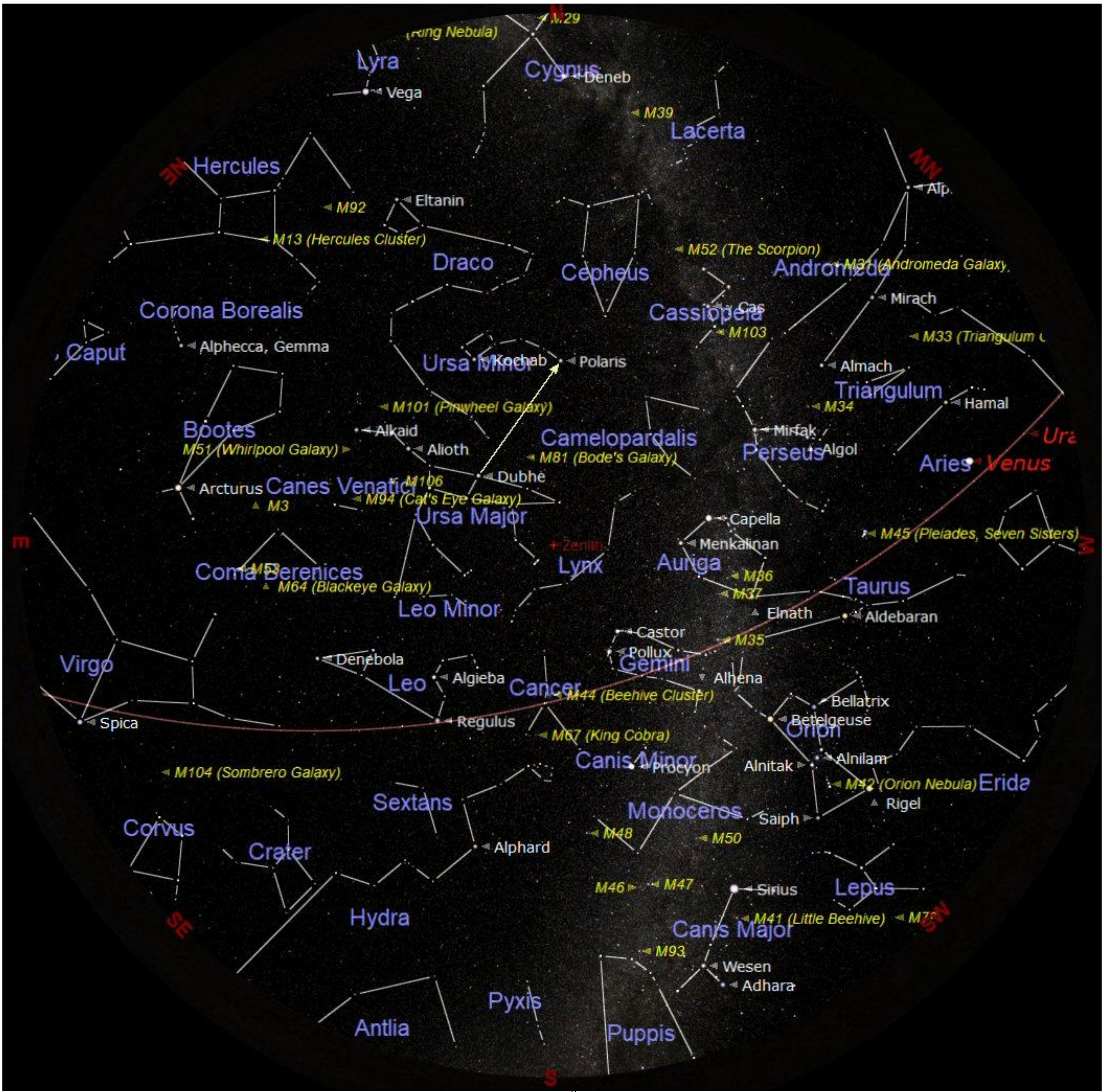
The second Super Moon effect is an optical illusion and is most noticeable during the summer months. It is caused by the Moon appearing low in the summer night sky. The 23.4° tilt in Earth's axis of rotation results in our view of the sky appearing to be tilted by the same amount. So during the summer the Sun appears higher in the daytime sky but the Moon and planets appear low in the night sky.

A full Moon always rises in the east as the Sun is setting in the west. So as the Moon rises over the horizon our eyes try to compare the size of the very distant Moon to the nearer features on the horizon. Our eyes are confused and try to relate the apparent size of the Moon to the features near the horizon and an optical illusion causes the Moon look larger.

The Super Moon Effect

So if a summer Full Moon coincides with the Moon's orbital Perigee then the Moon can look particularly large as it rises over the eastern horizon. This due to it really appearing larger combined with the optical illusion.

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th March at 21:00 (9 o'clock) in the evening Greenwich Meantime 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 10 o'clock GMT at the beginning of the month and at 8 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 easy to find. This month it is high in the east almost 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.

Planets observable: Uranus and Venus in the early evening with Mars, Saturn and Jupiter early morning.

REMEMBER British Summer Time (BST) begins on 29th March