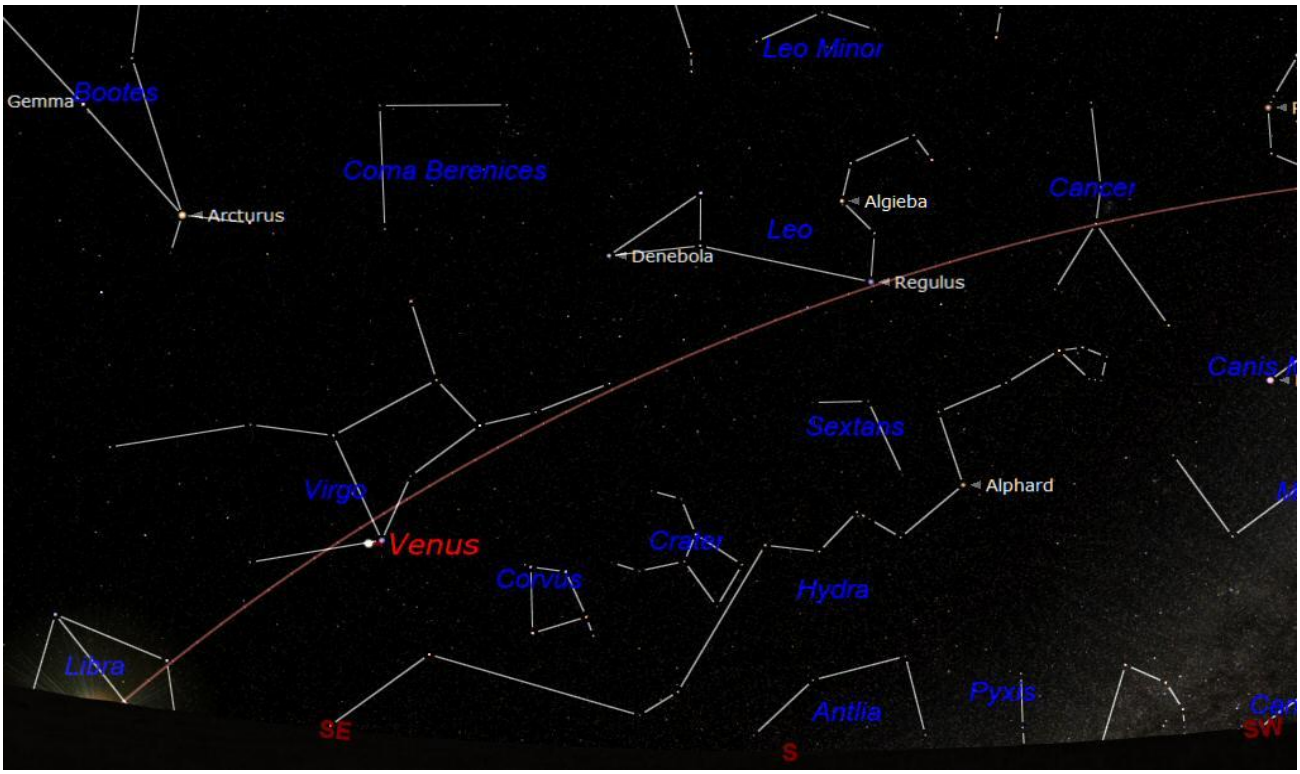
NEWBURY ASTRONOMICAL SOCIETY
MONTHLY MAGAZINE – NOVEMBER 2018

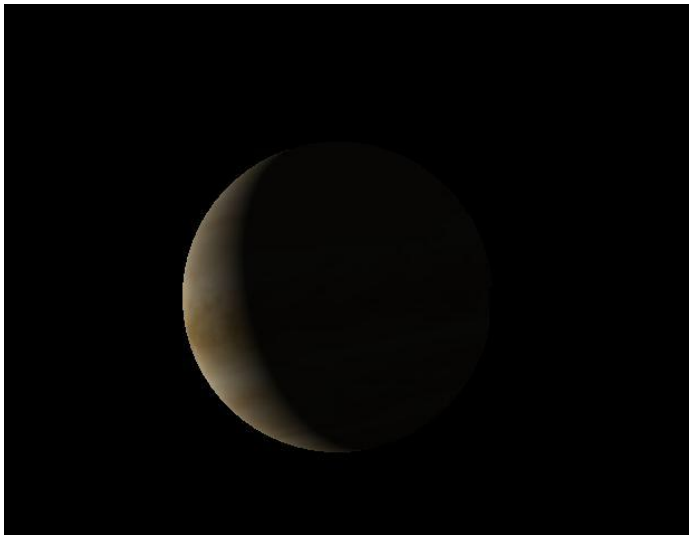
VENUS – 'The Morning Star'



Venus in the south east at 08:00 on 15th November

The planet Venus is now rising in the east just before sunrise. It was at 'Inferior Conjunction' (passing in front of the Sun) on 26th October so has been too close to the Sun to see. Venus did not pass directly in front of the Sun (a transit, this is a rare occurrence), it passed below the Sun. It is now appearing to moving away from the Sun and moving into view in the early morning.

Venus is almost directly between Earth and the Sun so the far side of Venus is illuminated and the side facing us on Earth is dark. Venus will appear large and have a 'New Moon appearance' phase, see the image below.



Venus as it will appear on 15th November.

Venus is very prominent in the east before sunrise and is often referred to as the 'Morning Star'. However a clear view to the west is required to see it this month.

Venus is currently between us and the Sun so it is relatively close to us and therefore looks comparatively large. As Venus moves around the Sun it will appear to move further to the west and away from the Sun. Its orbit will take it around the Sun and eventually behind the Sun. As it moves around its orbit it will move further away from us and appear to become smaller.

Its phase (crescent shape) will widen until it reaches the other side of the Sun when it will appear to be fully illuminated but smaller in diameter. It will then pass behind the Sun in 'Superior Conjunction' to re-emerge as the 'Evening Star' in the west after sunset.

Venus is completely covered in white cloud and therefore appears featureless but very bright. This is due to three factors: It is closer to the Sun so receives more sunlight than Earth, the white cloud reflects a large proportion of sunlight and Venus is close to us.

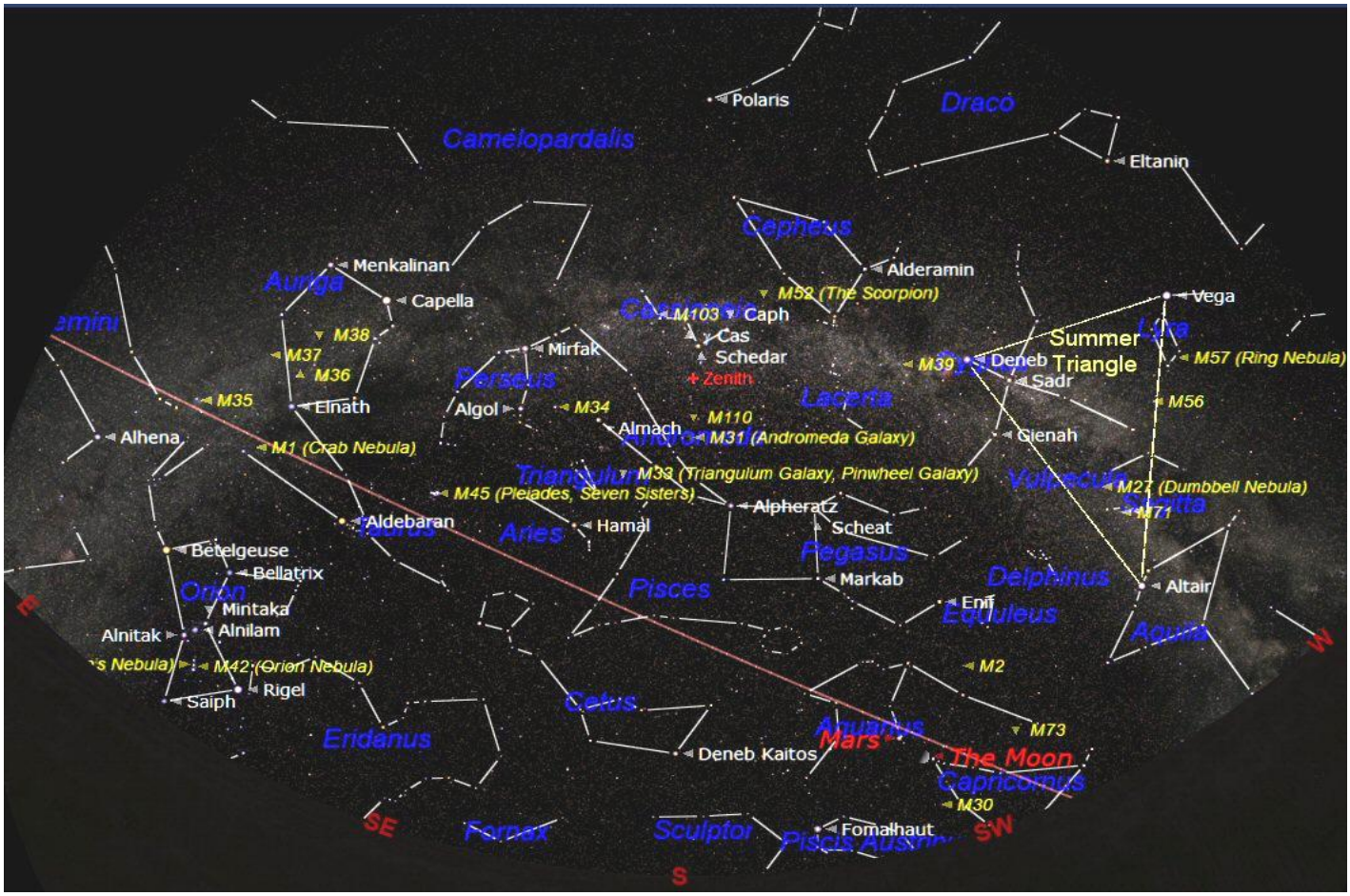
NEWBURY ASTRONOMICAL SOCIETY

2nd November Great Comets, Great Disappointments
Website: **www.newburyastro.org.uk**

NEXT NEWBURY BEGINNERS MEETING

21st November 10 Easy Eyepieces
Website: **www.naasbeginners.co.uk**

A TOUR OF THE NIGHT SKY - NOVEMBER 2018



The chart above shows the night sky looking south at about 22:00 GMT on 15th November. West is to the right and east to the left. The point in the sky directly overhead is known as the Zenith or Nadir and is shown at the 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 Capricornus (the Goat), Aquarius (the Water Carrier), Piscis (the Fishes), Aries (the Ram) Taurus (the Bull) and Gemini (the Twins). Also see page 8.

The summer constellations are still prominent in the western night sky. We still have the familiar Summer Triangle with its three corners marked by the bright stars: Deneb in the constellation of Cygnus, Vega in Lyra, and Altair in Aquila. The Summer Triangle is very prominent and can be used as the starting point to find our way around the night sky.

The Milky Way (our Galaxy) flows down through the Summer Triangle passing through Cygnus and Aquila to the western horizon. From Cygnus the Milky Way loops up through Cassiopea which is overhead see the Zenith (point in the sky directly overhead) marked on the chart above. It continues on through Perseus, Auriga and down to the eastern horizon as it passes through Orion and Gemini.

Mars is still in a good position for observing for the next couple of months.

At the top, centre of the chart above is the fairly faint constellation of Ursa Minor (the Little Bear) also called the Little Dipper by the Americans. Although Ursa Minor may be a little difficult to find in a light polluted sky it is one of the most important constellations. This is because Polaris (the 'Pole' or 'North Star') is located in Ursa Minor. See the following pages.

Polaris is the star that is located at the approximate position in the sky where an imaginary line projected from Earth's North Pole would point to. As the Earth rotates on its axis, the sky appears to rotate around Polaris once every 24 hours. This means Polaris is the only 'bright' star that appears to remain stationary in the night sky as Earth rotates every 24 hours.

To the East of the Summer Triangle is the constellation of Pegasus (the Winged Horse). The main feature of Pegasus is the square formed by the four brightest stars. This asterism (shape) is known as the Great Square of Pegasus. The square is larger than might be expected but once found is easier to find again.

Along the Ecliptic is the constellation of Taurus (the Bull). The stick figure representation of Taurus resembles a squashed 'X' with the bright orange coloured Red Giant star Aldebaran at its centre. This is a lovely star to look at especially using binoculars or a telescope and does look noticeably orange in colour.

Following the western (right), Northern (upper) arm of the 'X' shape of Taurus guides is to the beautiful Pleiades Open Star Cluster. This is a cluster of seven bright 'naked eye' stars known as the 'Seven Sisters'. See pages 5 and 6.

EXPLAINING ASTRONOMY – CELESTIAL AND ALTAZIMUTH COORDINATES

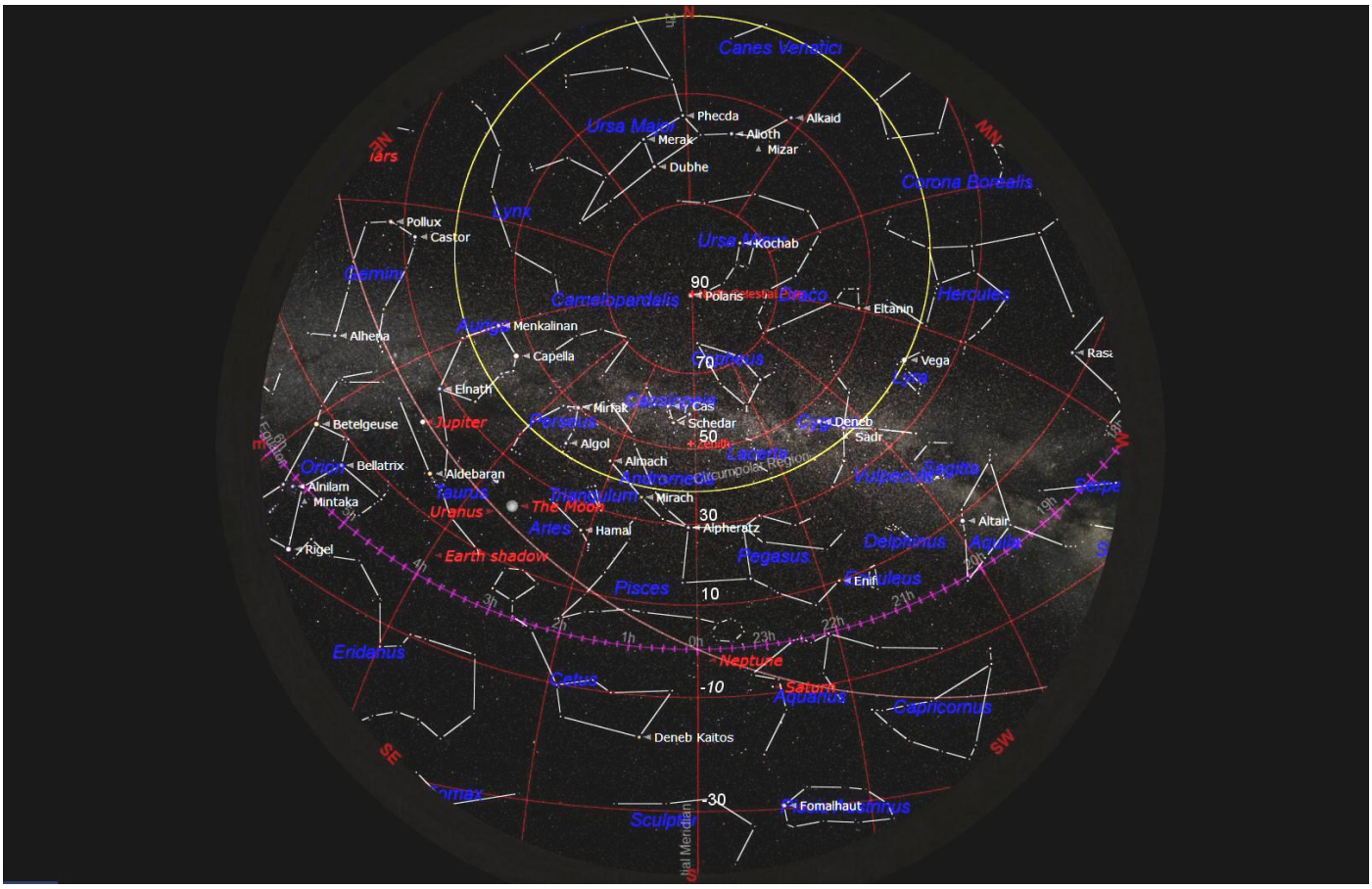


Chart showing the Celestial Coordinate Grid System

Our view of our night sky is complicated because Earth, our vantage point in space, is tilted over at 23.4°. This means we have two equators and two sets of poles to consider. The first is the equator of the Solar System dominated by the Sun. The Sun and its entourage of planets and other Solar system bodies rotate on a plane dictated by the rotational axis of the Sun. We call these the **Celestial Poles** and **Celestial Equator** (called the **Ecliptic** and also known as the Zodiac). The Ecliptic is shown as the curved 'orange' line along which the Sun, Moon and planets appear to move across our sky.

The chart above shows the night sky on 15th November at about 21:00 with the Celestial Grid super imposed. The north pole of the Celestial Grid is centred on the star Polaris in the constellation of Ursa Minor (the Little Bear). This is significant because the tilted north axis of rotation of Earth points towards this point in our sky and is therefore called the North Celestial Pole.

Polaris is not exactly on the Celestial Pole it is just 40.5 arc-minutes away from this point in the sky. Polaris is near enough to the Celestial Pole so it is the only star that appears not to move as Earth rotates. Polaris is located to the north of the point in the sky directly overhead that we call the **Zenith** which is marked on the chart above. As Polaris appears not to move and is always to the north of the Zenith we also call it 'the North Star' or 'the Pole Star'.

Earth's axial tilt of 23.4° is permanent but Earth has a wobble similar to a slowing down Spinning Top, called precession. This causes the Celestial Pole to move around in a circle every 26,000 years.

The Celestial grid is superimposed on the sky and appears to rotate once every 24 hours as Earth rotates on its axis. This means the whole sky appears rotate about Polaris (where Earth's axis is pointing) once every 24 hours (one rotation of Earth on its axis [a day]).

On the chart above the Celestial Equator is shown as the purple graduated line around the sky in the lower half of the chart. This line is divided into 24 hours of Right Ascension (R.A.). This measurement of rotation of Earth is used to define the part of the sky to be observed. The zero point was originally set as a point in the Constellation of Aires and is called 'the First Point of Aires'. However the First Point of Aires is not a fixed point in space so it moved into the neighbouring constellation of Pisces in the year 70BC. It has since moved half way across Pisces due to the effect of Precession. See the bottom of the previous column.

The grid lines above the Celestial Equator are graduated in degrees of angle (0° to +90°) above the Celestial Equator 'North' and (0° to -90°) below 'South'. This angle is used to measure the elevation or declination of a telescope and is called 'Declination'. So +90° is the North Celestial Pole (Polaris), 0° is the Celestial Equator and -90° is the South Celestial Pole.

Above the yellow circle around the pole at about +38° Declination, stars do not set below the northern horizon and are called 'Circumpolar'. This means these stars and some constellations are visible all year round. The constellation of Ursa Major (the Plough) is the most obvious Circumpolar constellation. It can be seen that the Zenith is almost on the +50° Declination gridline.

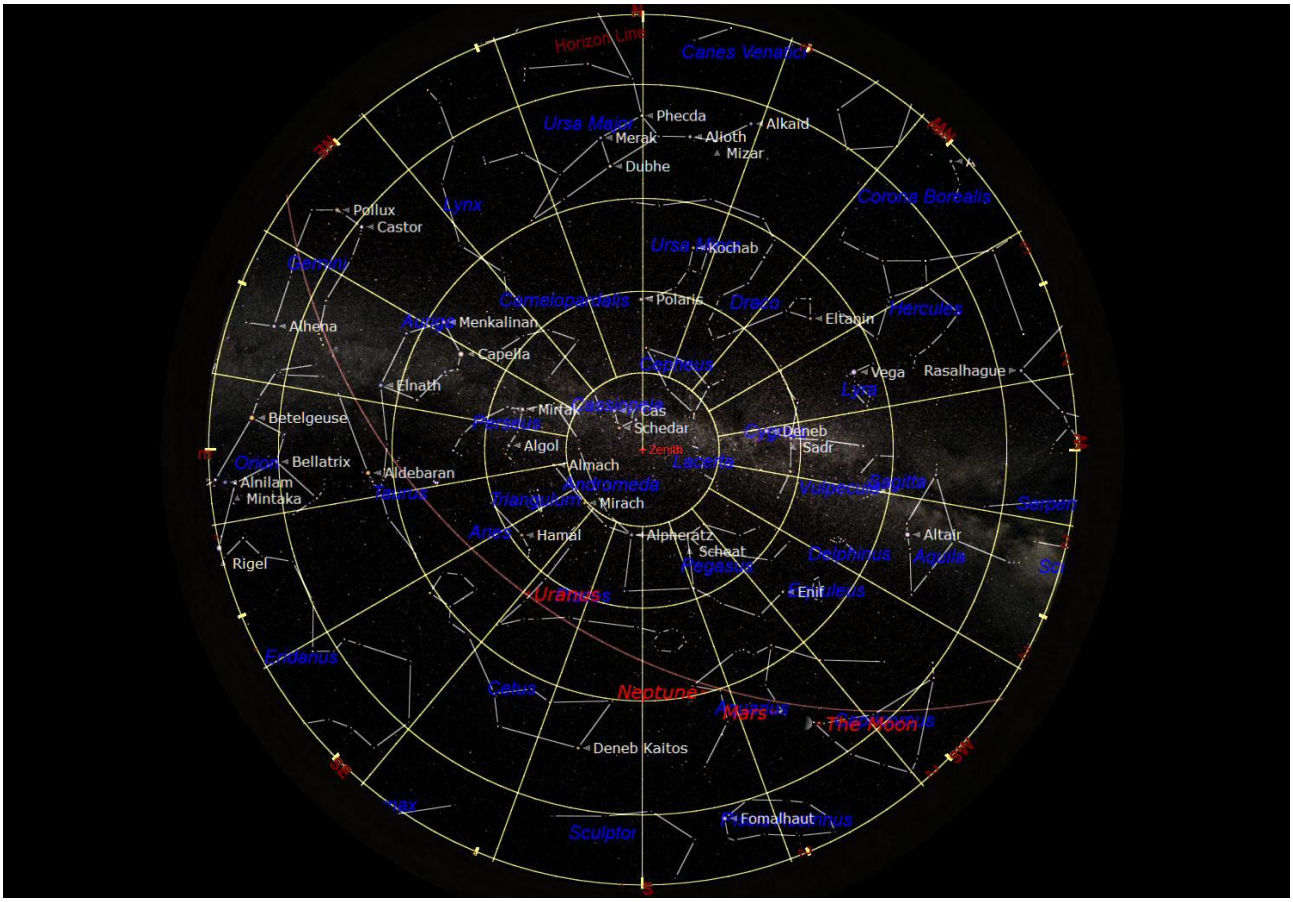
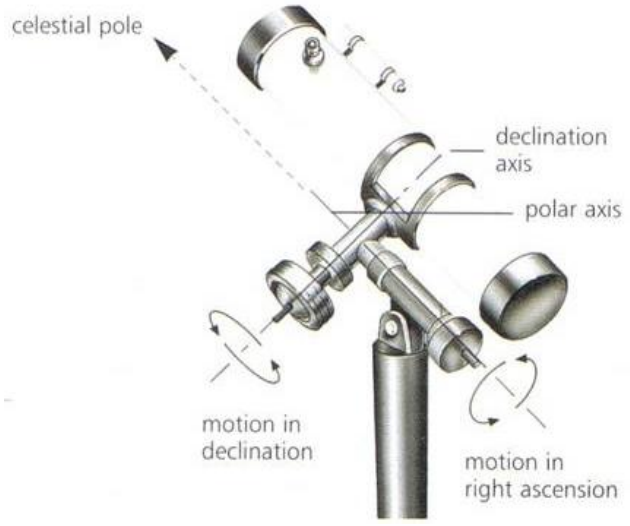


Chart showing the Altazimuth Coordinate Grid System

From an astronomer's point of view this 23.4° tilt of Earth's axis of rotation presents a problem. All the objects in the sky except Polaris appear to move across the sky in an arc. When looking towards the south, the stars, planets, our Moon and the Sun rise in the east cross the sky in an arc and set in the west. This means that for a telescope to track these objects the telescope mount has to be moved in two directions at the same time. Up or down and east to west.

Fortunately there is an easy way to solve this problem. We can tilt the Right Ascension axis (known as R.A.) over to the same angle as Earth's axis so that it points towards Polaris. It can now track any object that the telescope is pointed at across the sky by moving just the RA axis. This is called an Equatorial Mount.



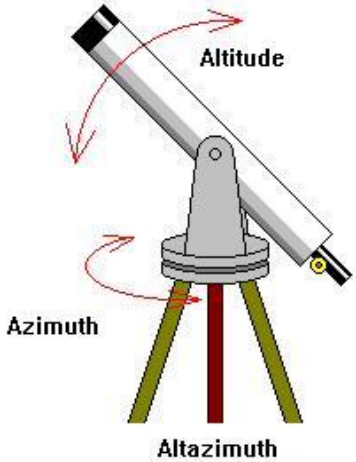
An Equatorial Mounting

So we would normally use the Celestial Coordinate system with an Equatorially Mounted telescope to make it easier to find and track objects in the sky. Using this coordinate system gives us a positional reference of an object in the form:

RA 15hr 30min 30sec Dec +47° 30min 30sec or

RA 15.5500hr Dec +47.5500° (in decimal format)

We can also use a system based on the Altazimuth coordinate system. This is used with a telescope mounted on a simple Altazimuth Mount.

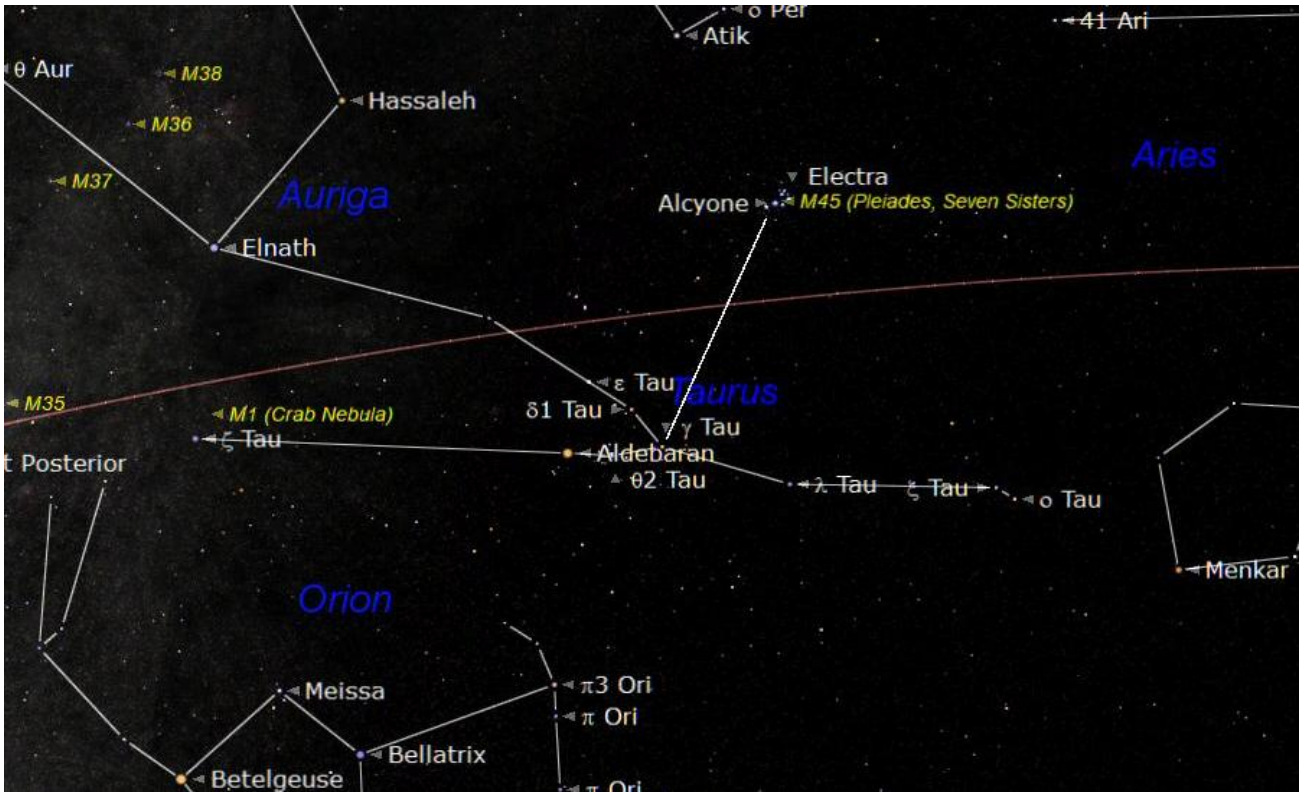


Altazimuth

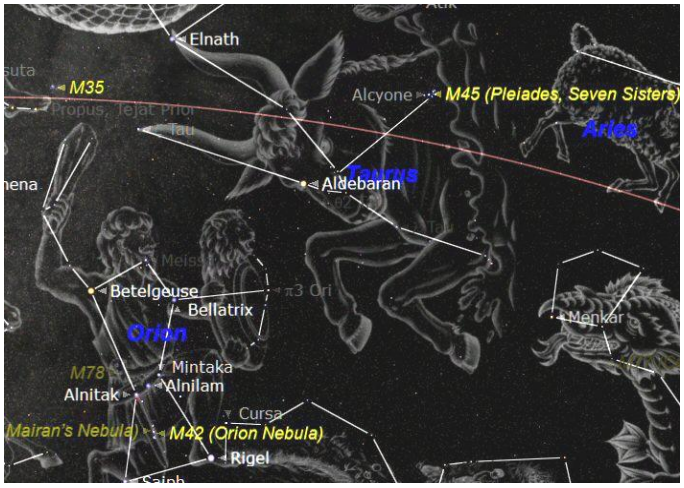
This coordinate system uses the local horizon as its zero position in Altitude (Alt) and the Zenith as its 90° position directly overhead of the observer. The zero position for Azimuth (east / west rotation) is North and movement east as degrees to the East 90° to South 180° and West 270°. This would normally be written as:

Alt 30° 30' (min) 30" (sec) Az 225° 30' (min) 30" (sec)

CONSTELLATION OF THE MONTH – TAURUS



The chart above shows the constellation of Taurus the Bull. There are many different representations of Taurus but he is generally shown with his horns tipped by the stars at the end of the obvious '>' shape. The bright red star Aldebaran is normally used to show the bull's eye.

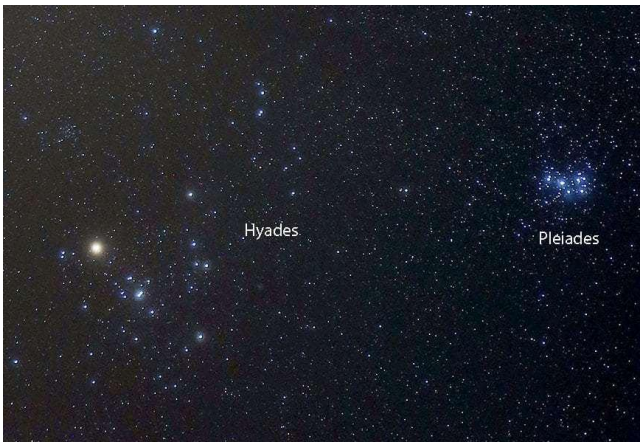


An illustration of the constellation of Taurus

With a little imagination Taurus appears to be charging Orion in the illustration. It sits on the Ecliptic and is one of the star signs of the Zodiac. The asterism (shape) used to identify Taurus resembles a stretched 'X'.

The bright red star Aldebaran is located at the centre of Taurus. It is easy to find and therefore helps to identify the constellation of Taurus. It is in fact a Red Giant Star and that is why it appears distinctly orange. A Red Giant is a star similar to our Sun (perhaps a little larger) that is approaching the end of life as a normal star. It has used up most of its Hydrogen fuel and has swollen into a giant. Its outer layers are now stretched over a larger area so the available heat is also spread over a bigger area so it is cooler and appears orange in colour.

Surrounding the bright red star Aldebaran is an Open Cluster of Stars known as the Hyades. It is an older cluster so its stars have begun to disperse. It is also quite far away from us so the stars appear quite faint. In a dark Moonless sky the cluster can be seen with the naked eye but is best seen using binoculars. The cluster is large, at 3.5° in diameter (about 7 Moon diameters) and well dispersed.



The Open Star Clusters Hyades and Pleiades

The real jewel of Taurus is without doubt the beautiful Open Cluster, Messier 45 (M45) also called the Pleiades or the Seven Sisters. An Open cluster is created as stars form in a giant cloud of gas and dust called a 'Nebula'.

M45 is visible to the naked eye initially looking like a patch of light. Closer observation will reveal a cluster of up to seven stars. Using a good pair of binoculars many more stars will be seen. There are in fact about 300 young stars in the cluster that is estimated to be about 100 million years old. M45 is one of the closest open clusters to us at 400 light years.

The Pleiades look brighter than the stars of the Hyades because they are very bright large young stars and are relatively close to us. The largest is Alcyone which is 10 times the mass of our Sun and 1000 times brighter. The larger and brighter stars of the Pleiades are also rotating very fast. The fastest is Pleione which is rotating 100 times faster than our Sun.

Messier 45 (M45) the Pleiades (Seven Sisters)

The stars of the Pleiades cluster would have formed from the gas and dust of a Nebula. Gravity draws the atoms of the Nebula together to form denser clumps of gas that become ever denser. Eventually the gas is squeezed into dense spheres where the pressure and high temperature at the core causes atoms to combine through Nuclear Fusion. As Hydrogen atoms are fused into Helium. Heat is produced and the sphere becomes a shining star. Any left-over gas and dust is blown away by intense radiation from the young stars and a cluster of new stars is revealed. This type of star cluster is called an 'Open Cluster'.

The biggest and brightest stars of M45 (the Seven Sisters) have been named after seven sisters from Greek Mythology. They were the seven daughters of the Titan called Atlas and the sea-nymph Pleione and were born on Mount Cyllene.

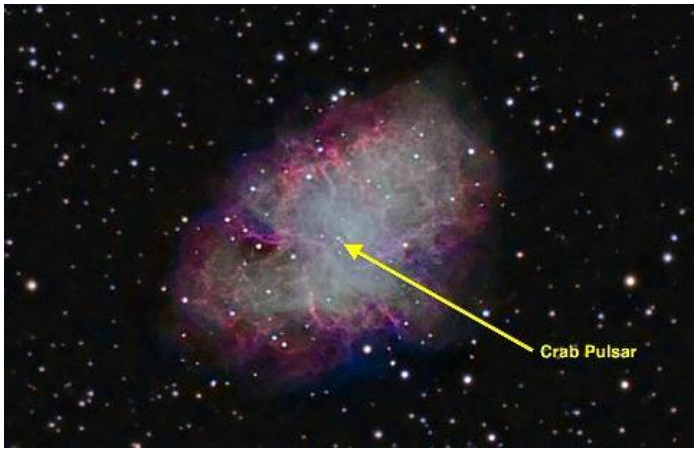
The names of the Seven Sisters

Impressive as they are, the Seven Sisters are just the brightest (naked eye) stars in a cluster of around 250 young stars. In the images above the Seven Sisters appear to be surrounded by gas remaining from the original nebula. However it is now thought the cluster is just passing through a cloud of Hydrogen gas in space.

Being so close to us the cluster has a relatively high apparent movement across the sky although it is still too slow for us to perceive. It will take 30,000 years to move a distance equal to the diameter of our Moon.

Although the cluster is moving through space the individual stars all have slightly different trajectories and relative speeds. Gradually over millions of years the stars will move further apart and the cluster will disperse, like the Hyades. Binoculars will reveal around 30 to 50 stars in the cluster and a telescope will reveal many more. However the cluster is too large to fit into the field of view of most telescopes so the outline of the cluster will be lost.

There is another very interesting object in Taurus. At the end of the lower left (eastern) arm of Taurus is Messier 1 (M1) the Crab Nebula. It can be seen using binoculars in a dark clear sky but really needs a telescope. From Aldebaran look east to the star ξ (Ksi) Tauri. Just above ξ Tauri is a small smudge of light, this is M1.



Messier 1 (M1) the Crab Nebula imaged by Hubble

This is the remnant of a giant star that exploded as a Supernova about 7000 years ago. Its light took 6000 years to reach Earth and was observed by Chinese astronomers in the year 1054 AD. It can still be seen in a dark clear sky as a 'fuzzy' patch of light using a medium sized telescope.

A Supernova is the 'death' of a star more than three times the mass of our Sun. Giant stars consume their Hydrogen fuel at an expediential faster rate than smaller stars. Consequently bigger stars do not 'live' as long as smaller stars. As stars begin to exhaust their supply of Hydrogen they develop into a Red Giant like Aldebaran. More massive stars develop into larger Red Giants.

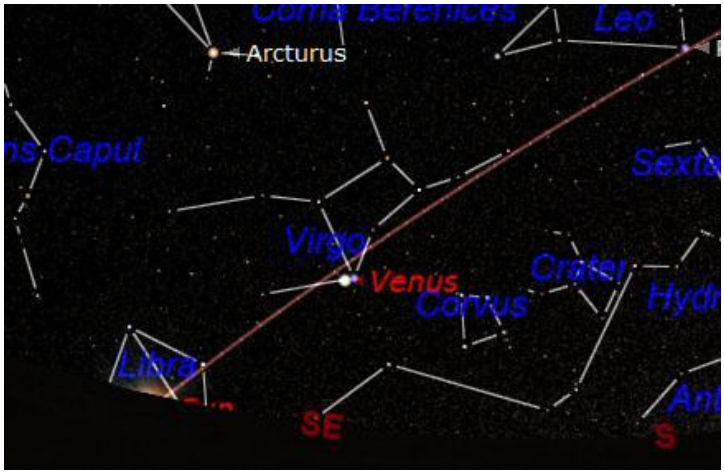
A star like our Sun and those up to about twice the mass of our Sun eventually slowly collapse as their fuel eventually runs out. The outer layers of the Red Giant drift away to form a gas bubble and the core 'gently' collapses to form a White Dwarf Star.

Stars two to three times the mass of our Sun come to a more dramatic end. As the fuel of a larger Red Giant Star finally runs out the star suddenly collapses and all the mass of the star falls inwards under the massive force of its own gravity. The collapse reaches a point where the pressure and heat causes a gigantic thermonuclear explosion. The outer regions are blown into space to create a Supernova Remnant like M1 and a dense Neutron Star about 12,000km in diameter. These tiny, super dense stars are also called 'Pulsars'.

THE SOLAR SYSTEM THIS MONTH

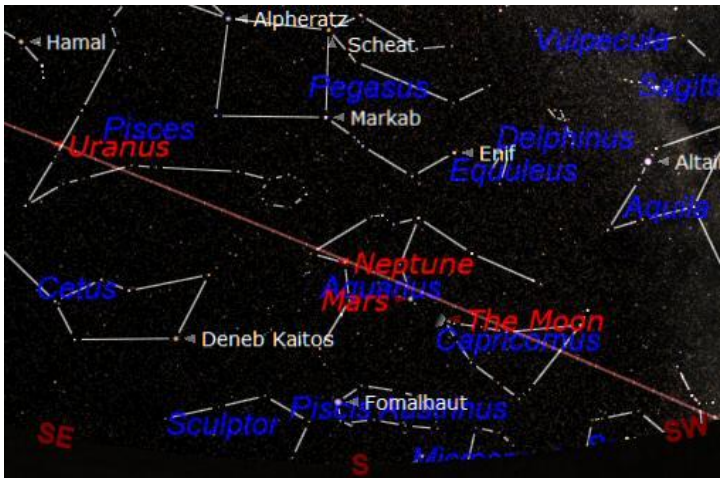
MERCURY will pass through Inferior Conjunction with the Sun on 27th November. This means it will pass in front of the Sun (not across the face of the Sun but just above). So it will be too close to the Sun to be seen.

VENUS was in Inferior conjunction (passing in front of the Sun) on 26th October. It is now emerging from the glare of the Sun. It rises over the eastern horizon at about 05:00 but will be difficult to see in the brightening sky.



Venus in the east at 05:00 GMT

MARS will still be well placed this month for observing but is very low over the southern horizon in turbulent and smoggy air. The Red Planet passed through 'Opposition' on 27th July so is still relatively close to Earth. It is 10.5 arc-seconds in diameter and is still bright at magnitude -1.3.



Uranus, Neptune and Mars at 20:00 GMT

JUPITER is moving into conjunction with the Sun on 26th November so it will not be visible this month.

SATURN is moving in too close to the Sun to be seen this month and will be lost in the glare of sunset.

URANUS will be in a good observable position in the south at midnight. Uranus will be quite high in the south east as soon as the sky is dark. A good pair of 9x50 binoculars will reveal a slightly fuzzy blue, star like, object. A telescope at a magnification of 100x will show it as a small blue/green disc. See the Mars chart above.

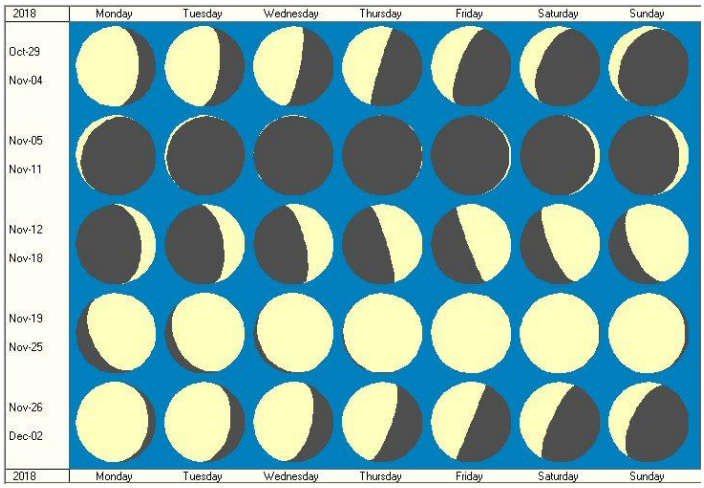
NEPTUNE is still in a very good position this month for those who have a telescope. A telescope will be needed to show Neptune as a small blue/green disc using a magnification of 100x but it is small and difficult to find.

THE SUN

There have been no sunspots over the past few months so it looks as though the active phase of the Solar Cycle is now over.

The Sun rises at 07:00 at the beginning of the month and at 06:40 by the end of the month. It will be setting at 16:30 at the beginning and 16:00 by the end of the month.

THE MOON PHASES IN NOVEMBER



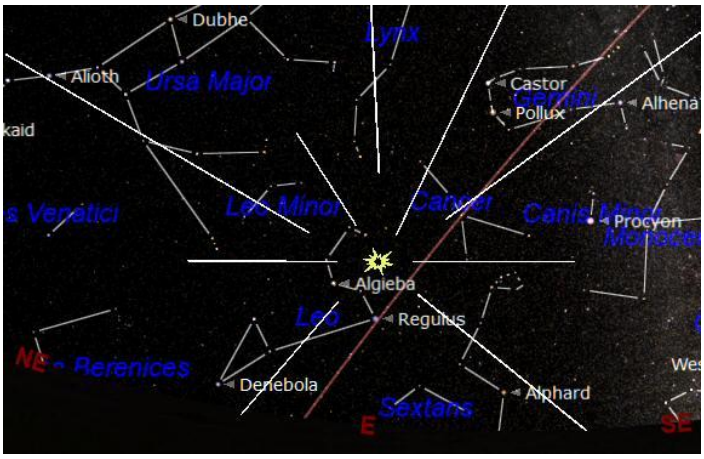
New Moon will be on the 7th November

First Quarter will be on 15th November

Full Moon will be on 23rd November

Last Quarter will be on 30th November

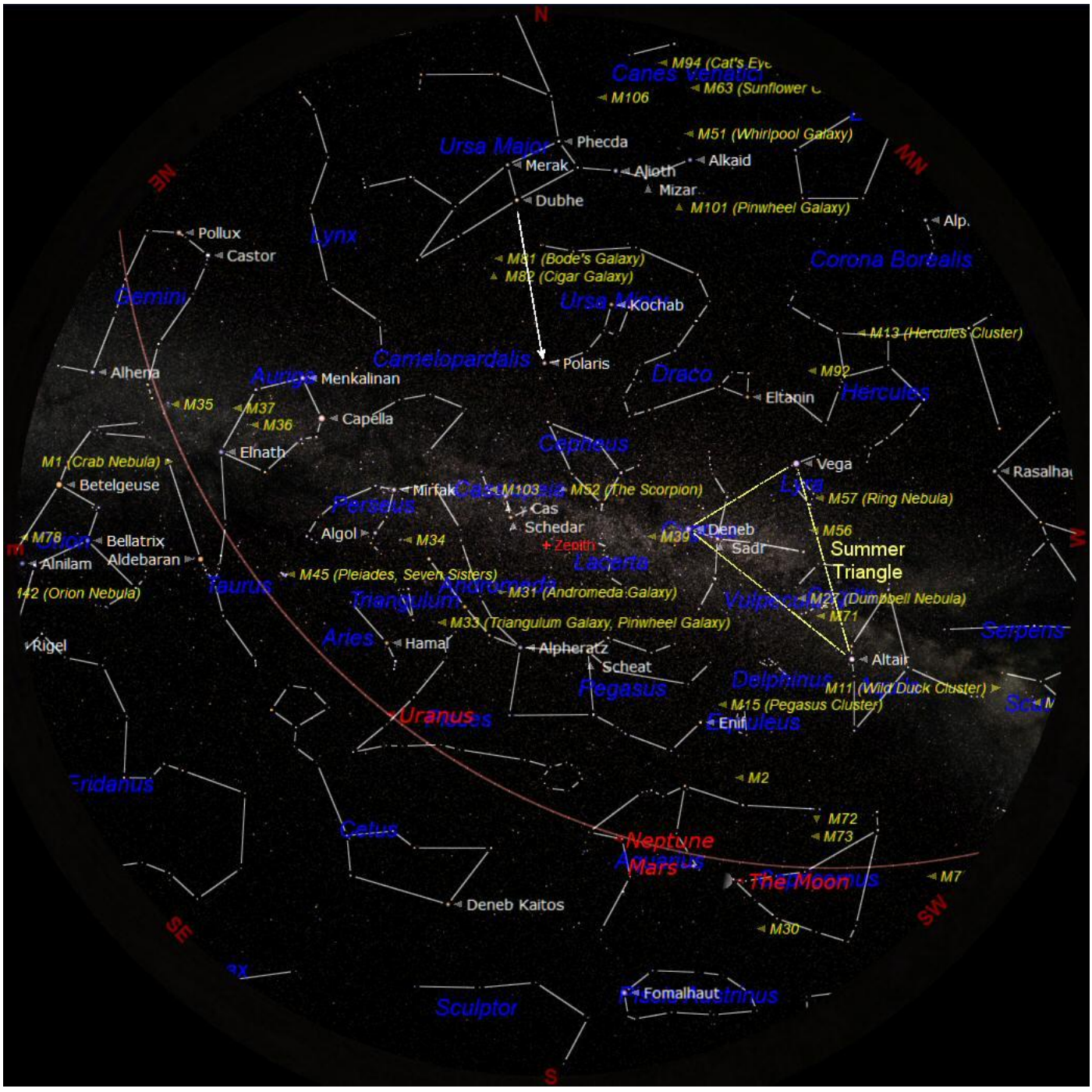
THE LEONID METEOR SHOWER



The chart above shows the night sky looking towards the east at 02:00 on 18th November when the constellation of Leo is rising over the eastern horizon. The radiant point of the Leonid Meteor Shower is shown close to the star Algieba. The paths of the meteors are shown by the straight lines emanating from the direction of the radiant point. The meteors are debris from Comet Temple Tuttle.

During the evening of 17th November the constellation of Leo will be below the eastern horizon so any Leonid meteors will appear to originate from over the horizon. This means all the meteors will be moving up from the eastern horizon and in a 'fan' shape across the sky. Leonid meteors tend to be fast and relatively bright so look anywhere from the eastern horizon to overhead. Make sure you are warm and comfortable and enjoy the show.

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th November at 21:00 (9 o'clock) in the evening 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 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 in the north. 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 this month: Mars, Uranus and Neptune.