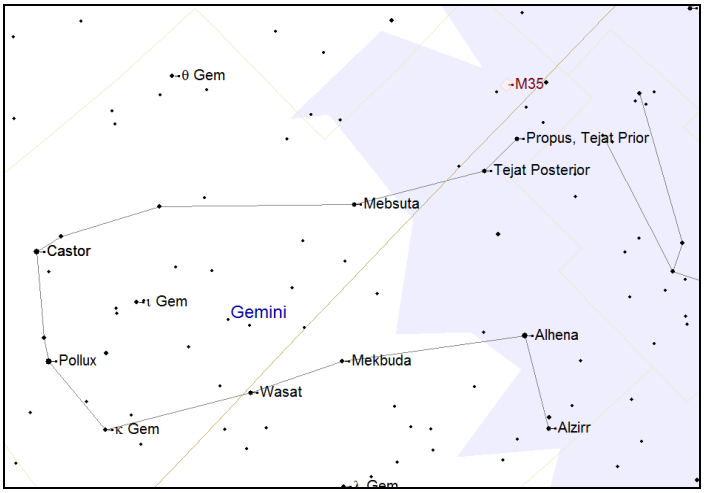
NEWBURY ASTRONOMICAL SOCIETY
BEGINNERS SECTION MAGAZINE – FEBRUARY 2011

THE CONSTELLATION OF GEMINI



Gemini is easy to find because of its two brightest stars which are close together and similar in appearance. The two brightest stars are called Pollux (β) and Castor (α) and are known as the Gemini Twins. The twins originated in a Greek myth which told that they had one mother but two fathers. Castor was the mortal son of King Tyndareus but Pollux was the immortal son of the God Zeus who had disguised himself as Cygnus the swan.

Gemini is located on the ecliptic and therefore is one of the constellations of the Zodiac. This means it sits on the imaginary line along which the Sun, Moon and the planets appear to travel across the sky. It is flanked on the ecliptic by Taurus to the west and Cancer to the east. To the south west is Orion and to the north is Auriga with its very bright white star Capella directly overhead at this time of the year. The recognised shape of Gemini is in the form of a rough rectangle with Pollux and Castor at the eastern short side. A line of stars runs south west from Castor to the star Tejat Posterior and Propus Tejat Prior. The line from Pollux takes a diversion south through kappa (κ) then south west through Wasat and on to Alhena and Alzirr.

Although Castor has been given the Greek letter designation α, which is normally given to the brightest star in a constellation, it is not actually the brightest. Pollux is in fact brighter at magnitude +1.59 compared to the +1.9 of Castor. However Castor is a double star with a fainter companion that has a magnitude of +2.9 and separated by 6 arc-seconds. The two stars, known as Castor A and Castor B, orbit their common centre of gravity every 467 years. The pair can be separated in a 75mm aperture telescope on a good clear night. See the double and multiple star article on page 3.

Each of the pair of stars that comprise Castor is in fact a double star in its own right. However they are much too close together to be separated in any telescope. The only way that their presence can be detected is by examining the light through a spectroscope. This instrument shows each star has two sets of spectral lines revealing that they are double stars. The Castor pair also has a faint companion, known as C, orbiting them. It is separated from A and B by about 72 arc-seconds but is at the same distance and has the same motion through space. This star is also a double making Castor a very unusual six star system.

There is one Messier object in Gemini which is one of the most beautiful open clusters. M35 is quite bright and can be seen using binoculars on a clear night but a small telescope is required to resolve the individual stars. When a medium size telescope is used a beautiful string of stars running through the centre of the cluster can be seen.

The Open Star Cluster M35 in Gemini

Just to the south east of the star Wasat (δ) is a very beautiful Planetary Nebula known as NGC 2392, the Eskimo Nebula. This nebula is visible in a 100 – 150mm telescope on a clear dark night and appears as a small but distinct disc. In a larger telescope it appears as a slightly bluish disc with a hint of a halo around it. Using a powerful telescope and a CCD Camera the 'parka hood' can be seen in detail as in the image below:

NGC 2392, The Eskimo Nebula, imaged by Hubble

THE NEXT BEGINNERS MEETING

16th February Open Star Clusters

Website: **www.naasbeginners.co.uk**

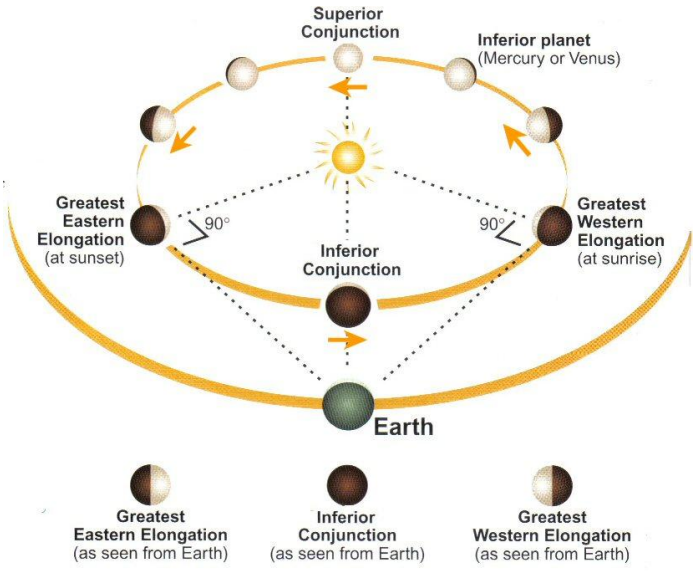
NEWBURY ASTRONOMICAL SOCIETY MEETING

4th February High Power Lasers Prof. Steven Rose

Website: **www.newburyas.org.uk**

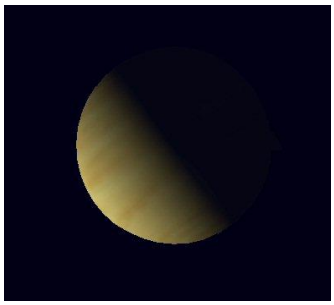
VENUS ON VIEW IN THE MORNING

Before sunrise Venus has been giving us a brilliant show in the east since before Christmas. It is now just at its best and still dazzlingly bright as the 'Morning Star' (as it is sometimes called). Venus passed through Inferior Conjunction with the Sun on the 29th October 2010. Inferior conjunctions occur when the inner planets, Mercury and Venus, pass between Earth and the Sun. It is now getting smaller as it moves further away from us to pass behind the Sun in Superior Conjunction.



The diagram above shows how the whole surface of Venus is dark when it is on the same side of the Sun to Earth at Inferior Conjunction. However we cannot see it because it is in front of or very close to the Sun. When Venus has moved around its orbit and subtends an angle of 90° between Earth and the Sun it is said to be at Greatest Western Elongation. This is the point where it appears to be at its furthest separation from the Sun. Venus reached this position on 8th January this year when it appeared to be half illuminated (like the half Moon) as shown in the lower right view in the diagram above, and on the left below.

After passing the point where Venus is side by side with the Sun it appears to begin to move back towards the Sun. More of the illuminated surface will be seen and the crescent shape becomes fuller (gibbous) as it moves further past the Sun. As Venus moves further round its orbit it will pass behind the Sun on 16th August in Superior Conjunction. The computer generated images below show how Venus looked at Greatest Western Elongation and how it will look before Superior Conjunction.



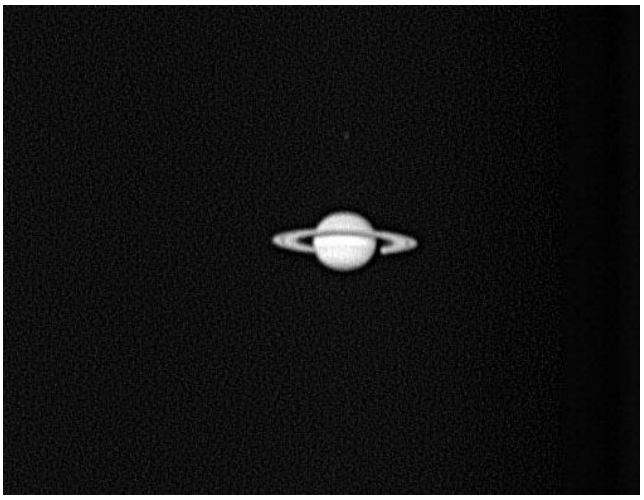
Venus on 8th January

Venus on 8th July

After passing behind the Sun Venus emerges as the 'Evening Star' visible in the west at sunset in late autumn. Gradually less of the illuminated side of the planet will be visible from Earth. The crescent shape will become narrower but Venus will appear larger so the brightness always remains about the same.

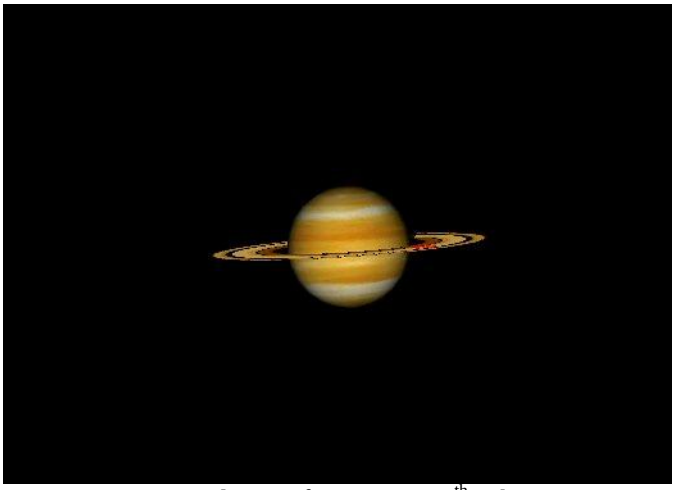
SATURN OBSERVABLE LATE EVENING

After months of being the target for the hardened early cold morning observer, Saturn is now in the evening sky. It rises over the eastern horizon by 23:00 at the beginning of February and by 22:00 at the end of February. It really needs about an hour to clear obstructions, turbulence and dirty air close to the horizon before it is observable.

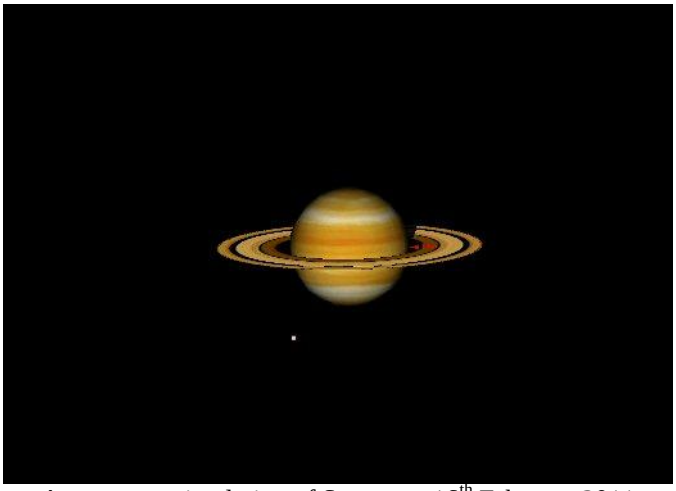


Saturn imaged by Steve Harris in 2008

The ring system is beginning to open up now after appearing very thin for the last two years. This was because the rings were viewed edge on from our vantage position here on Earth. See the images below.



A computer simulation of Saturn on 16th February 2010



A computer simulation of Saturn on 16th February 2011

DOUBLE AND MULTIPLE STAR SYSTEMS

Our Sun is of course a star and in many ways is a perfectly ordinary star. It is classified as a yellow dwarf and as such is a member of the largest class comprised of middle sized stars. It is slightly unusual in a number of ways but significantly from the point of view of this article in that it is a single star and not a member of a double or multiple star system. It is now thought that the majority of stars are gravitationally associated with at least one other star.

There are many classes and types of double and multiple stars but before we consider types there are two major different classes. This distinction is between those that are really associated and those that are simply in the same line of sight and not really associated at all. A number of what appear to be double stars are actually further apart from each other than the distance the closest star is from us. It is rather like seeing two street lights that appear close together but in reality one is brighter but further away than the other. Line of site doubles are however quite rare compared to associated pairs.

Albireo in Cygnus is probably a line-of-sight double

True double stars are very common with some estimates as high as 60% or even more for double or multiple star systems. The physical connection between some double stars was first realised by Sir William Herschel nearly 200 years ago. He was attempting to measure the distances to stars over a long period and realised some double stars had moved relative to their partner. These stars became known as Binary Stars.

Binary stars tend to have similar masses and it is very unusual for one to be more than two or three times as massive as the other. One star does not orbit the other in a binary system; they both orbit a common centre of gravity. This can be likened to two skaters holding hands and spinning each other around. They will rotate around a point approximately at the position of their clasped hands. Using the same example it would be difficult for a pair of skaters of greatly disproportionate weights to spin around without the smaller being pulled over. Two stars of equal mass will have their centre of gravity equidistant between them. If one star is more massive the centre of gravity will be closer to the larger star.

Binary stars are very useful for working out the orbits of the components and their masses. By carefully measuring the motions of the stars the orbital time can be derived. From this the mass of each star can be calculated. Most of the binary systems have had their details determined by professional astronomers and a great deal is known about them. However some binary stars have very large separations and may take a million years or more to complete one orbit.

Professional astronomers do not have time to spend observing binary stars so they rely on amateurs to collect data for them to analyse and use in their calculations. Many amateur astronomers specialise in collecting data from binary stars and often have favourite stars that they monitor continuously over many years. Data is collated together by allocated people around the world and passed on to the professionals for their research. In this way amateur astronomers can still make a valuable contribution to front line science through their hobby.

To be able to make a useful contribution the amateur does need a reasonably sized and good quality telescope. However, equipment is comparatively low priced these days and most enthusiastic amateurs can afford the equipment to make a start. Help and advice can be obtained from organisations such as the British Astronomical Association (BAA).

A telescope accessory that is required is an eyepiece fitted with a micrometer. This is a special eyepiece that has engraved cross hairs, circles and protractor angle markings. It also has a screwed measuring device attached. The brighter of the two stars, which is allocated the letter ‘A’, is centred in the cross hairs. The position of the companion ‘B’ is then determined using the concentric circles to measure the distance from A and the protractor lines used to measure its angle. Distances between stars are measured in seconds of arc (arc seconds). An arc second is 1/60 of a minute of arc which in turn is 1/60 of a degree. Therefore one second of arc is 1/3600 of a degree. To put this in perspective the full Moon is half a degree in diameter, which is 30 arc minutes (written as 30′) or 1,800 arc seconds (written as 1,800″).

To give an idea of the separation of binary stars the naked eye double star system Mizar and Alcol in Ursa Major is about 700 arc seconds apart. When a telescope is used to look at Mizar it is a close binary itself. The separation of the Mizar pair is approximately 14 arc seconds, written as 14″. Many stars are a lot closer than this so the closer they are the better the equipment needed to separate them.

Here are some examples of different types of associated stars:

BINARY PAIR These are a pair of stars gravitationally linked.

LINE OF SIGHT PAIR A pair of stars that appear close together but are just in the same line of sight to us and not associated.

TRIPLE STAR SYSTEM Three stars that are gravitationally associated. Often a close binary with a third star orbiting the pair.

QUADRUPLE SYSTEM Often two binary star systems that are gravitationally associated with each other.

OTHER MULTIPLE SYSTEMS Star systems of up to six gravitationally associated stars are known.

ECLIPSING BINARY This is a system where the stars regularly pass in front of each other causing a change in brightness.

There are also systems made up of different types of star making quite exotic systems.

NORMAL STAR AND A WHITE DWARF

NEUTRON STARS IN THE SYSTEM

BLACK HOLES in association with other star types.

RED GIANT STAR AND SMALLER COMPANION The smaller and denser star may pull material off the bloated red giant.

ULTRA CLOSE BINARY These may be so close that their gravity has pulled the stars into an egg shape and even transfer material.

SPECTROSCOPIC BINARY Two stars so close that they can only be identified from there being two separate spectra.

OBSERVING DOUBLE STARS

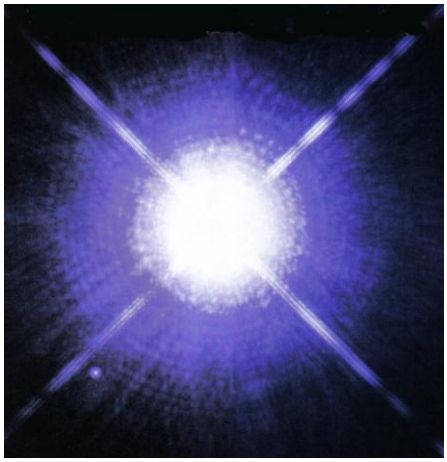
Double stars are great to find and look at but most do need a telescope. There is however a number of double stars that can be seen with a pair of binoculars or even with the naked eye. Perhaps the best naked eye double is Mizar in the handle of the Plough – Ursa Major.

Ursa Major showing Mizar, imaged by Richard Fleet

At the centre of the three stars forming the handle of the the Plough is a famous naked eye double star Mizar and its companion Alcor. Viewed through powerful binoculars or a telescope Mizar is seen to be a double star itself. When the light from the two Mizar stars is split using a spectroscope each star is seen also to be double making this a five star system. Each of the Mizar pairs is too close to be separated using any amateur telescope and is therefore known as a Spectroscopic Binary.

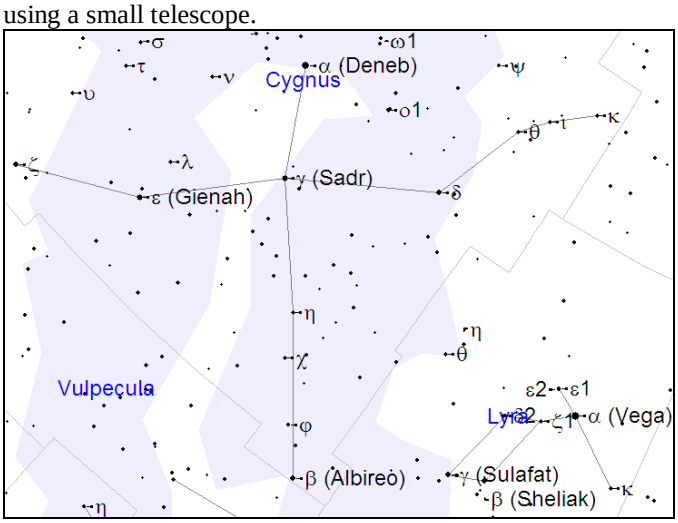
Another very interesting double star is Sirius in the constellation of Canis Major. Sirius is the bright star to the lower left of Orion and is known as his large hunting dog or the 'Dog Star'. To find Sirius, follow the line of Orion's belt down for about six belt lengths and you will find a bright flashing star, this is Sirius. Sirius is the closest star that we can see from Britain, only 9 light years away, and is therefore our brightest star.

Sirius is a large hot white star but with a tiny White Dwarf companion. This white dwarf is known as Sirius B and is the remains of a star like our Sun or perhaps a little larger. It passed through the star aging process of becoming a Red Giant as its Hydrogen fuel ran out. When the nuclear reactions that had powered the star stopped, the star collapsed. It is now only the size of Earth but still weighs as much as a star and is therefore very dense. It has become a white hot, super heavy, fast spinning cinder. Sirius B cannot be seen through a telescope but it is interesting to know that it is there when we look at Sirius.



Sirius and Sirius B 'The Pup' (lower left)

The Double Double in the constellation of Lyra is exactly what it says: a pair of double stars. The pair is visible using a good pair of 10 x 50 binoculars but it is quite difficult to separate the pair. The stars are however easily separated using a small telescope.



The constellations of Cygnus and Lyra

The double double has the official identification ε (epsilon) Lyrae and is the 5th star in Lyra. In the chart above it can be found just north (above) the brightest star α (Vega). The two pairs of the double double are labelled as ε1 and ε2 and are separated by 208″. In turn each pair is separated by just 2″, about 160 AU (1 AU = Earth / Sun distance). The four stars of this system have magnitudes between 5 and 6 and a medium sized telescope with high magnification is required to separate them. There is more though: the brighter component of ε1 is also a Spectroscopic Binary making this a five star system. This whole system is 125 light years from us.

The constellation of Cygnus, which is also shown in the chart above, is host to one of the most beautiful double stars in the sky. The star is β (beta) Cygni and named Albireo. Albireo has one bright gold coloured star and one blue. See the image on page 3. The contrast in colour is quite obvious because of the closeness of the two stars. By adjusting the focuser of a telescope so the stars appear out of focus the contrast is enhanced even further. The pair is almost certainly not a true double; the stars are just in the same line of sight. There is a couple of other pairs with contrasting colours like Albireo; these are γ (gamma) Andromedae – Alamak and ι (iota) Trianguli. Amazingly all the stars in these two systems are also Spectroscopic Binaries.

The constellation of Orion is host to a number of interesting double stars. The most famous is Rigel, the giant white star at the lower right of Orion. Because Rigel is so bright at magnitude 0.1 its companion is difficult to see at a mere magnitude 7. Other doubles in Orion are:

ζ (zeta) Alnitak, the left star of Orion's belt. This is a 2nd and 3rd magnitude tight double that requires a 100mm telescope.

δ (delta) Mintaka, the right star in the belt, is a magnitude 2 blue-white primary with a 7th magnitude companion.

ι (iota) Nair al Saif located just below M42 is an unequal double having components with magnitudes of 3 and 7. In the same field of view is another 4th and 6th magnitude pair.

σ (sigma) is located just south of ζ (zeta) Alnitak and is a stunning multiple star. Binoculars will show a 4th magnitude blue-white star with a 7th magnitude companion. A small telescope will show two closer companions that make σ look like a planet with moons. Close by is a triple star system called Struve 761 that is shaped like a thin triangle.

THE SOLAR SYSTEM THIS MONTH

MERCURY rises in the south east just before the Sun at the beginning of the month and moves closer towards the Sun as the month progresses. However it will be too close to the Sun and the horizon to be seen this month.

VENUS rises over the eastern horizon at about 05:00 at the beginning of the month and is visible as a bright star in the early morning sky until about 07:00 when the sky brightens. A telescope will show its crescent shaped phases. See Page 2.

MARS is in conjunction (behind) the Sun and will not be visible until it reappears as a very early morning object later this year. During May it will have an interesting grouping with Mercury, Venus and Jupiter in the east just before sunrise.

JUPITER will still be visible briefly after sunset in the south west as the sky darkens at the beginning of the month. However it will be setting in the west at about 20:00. Jupiter is worth a look even in a small telescope or binoculars. The four brightest moons change position from night to night. A larger telescope may show the moons pass behind or in front of the planet. When a moon passes in front of the planet (in transit) it may cast its shadow on the surface of Jupiter producing an eclipse shadow. The image below shows the moon Europa to the right with its eclipse shadow on Jupiter. To the left is Ganymede, with Io further out.

Jupiter imaged by Steve Harris on 5th December 2010

Jupiter's South Equatorial Belt has just started to re-appear after being absent since Jupiter emerged from conjunction with the Sun last year. South is at the top of these two images.

Jupiter imaged by Steve Harris on 9th January 2011

SATURN rises over the eastern horizon at about 23:00 at the beginning of the month and 21:30 by the end of the month. It will be well positioned due south at 06:00 by mid month. The rings are opening out now after being closed up and almost disappearing last year. See Page 2.

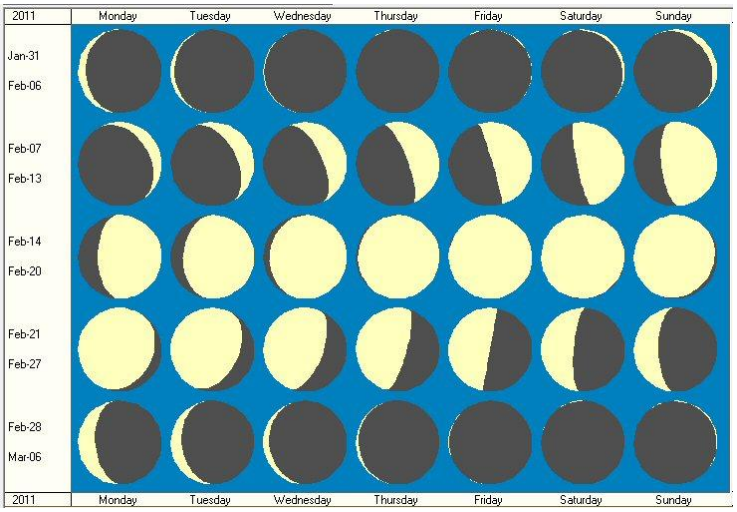
URANUS is just to the west (right) of Jupiter throughout the month and is in a good position to make it easy to find in a 100mm to 150mm telescope.

NEPTUNE moves into conjunction with the Sun in the middle of this month and will not be observable.

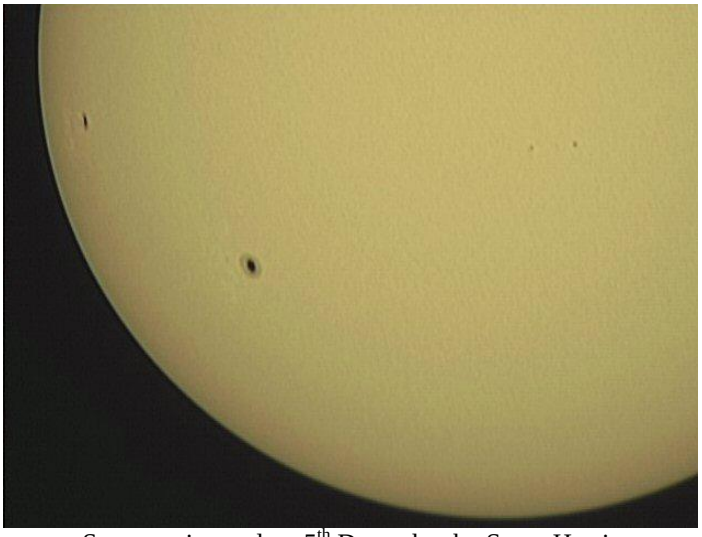
METEORS. There are no meteor showers this month but there may still be the odd sporadic meteor to be seen.

THE MOON is always a good target for binoculars or a small telescope. It is also the first object for a beginner to go for because it is large and bright. The best times for observing the Moon will be during the periods 7th – 14th and 22nd – 28th February. During these times the terminator (the boundary between light and dark) will cross the surface bringing different areas into better view due to the long shadows being cast by the sunlight.

The phases of the Moon during February 2011:



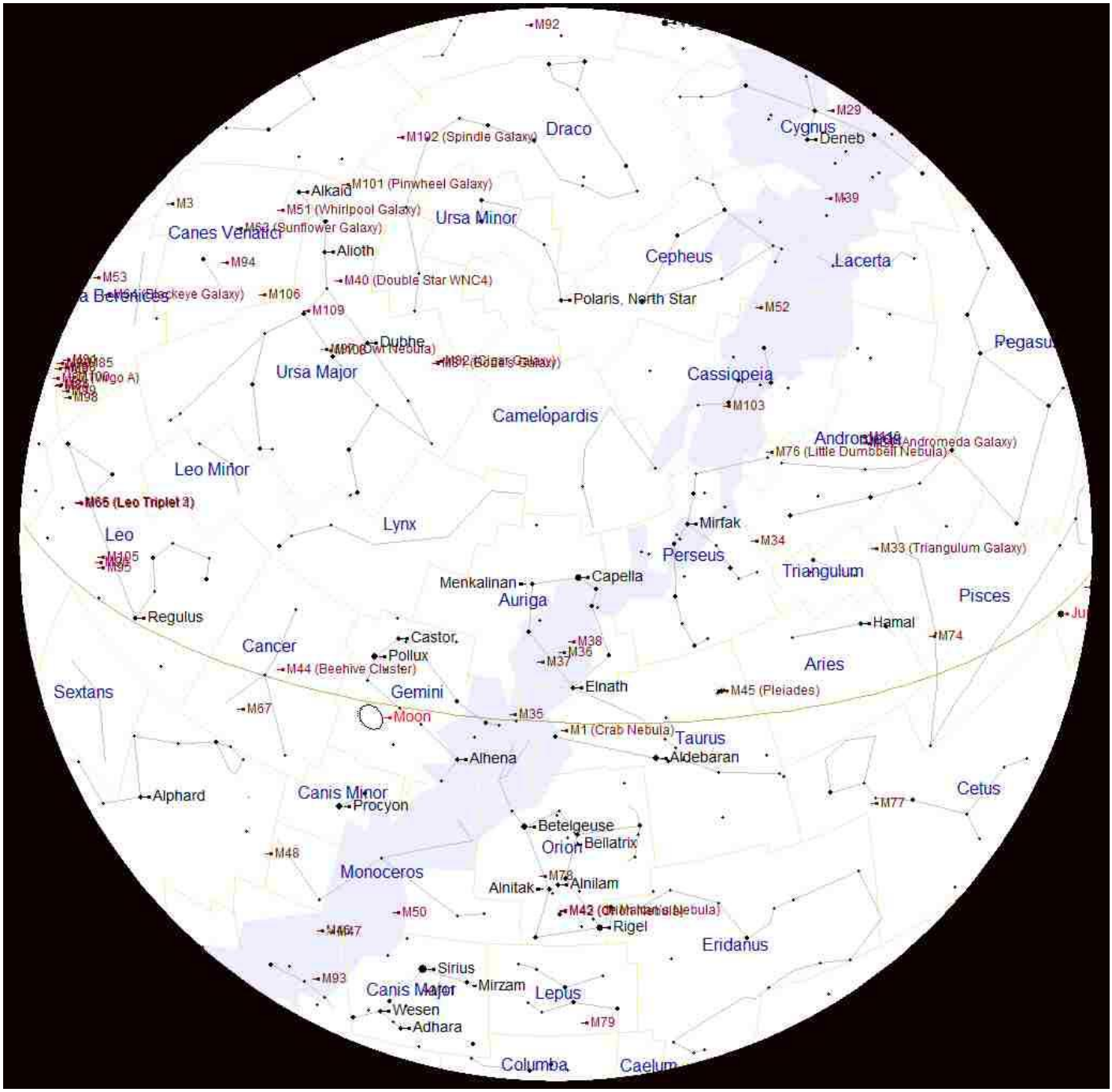
THE SUN has an eleven year cycle of increasing sunspot activity. The period of maximum activity has been very sparse until a few months ago, however a number of large spots appeared during December 2010. The Solar maximum will reach its expected peak during 2013 when there should be more activity and Sun Spots.



Sunspots imaged on 5th December by Steve Harris

A special solar filter must be fitted to a telescope to view the Sun or alternatively the image can be projected on to a screen.
DO NOT LOOK DIRECTLY AT THE SUN AS IT WILL CAUSE BLINDNESS, EVEN WHEN ECLIPSED.

THE SKY THIS MONTH



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

The centre of the chart will be the position in the sky directly overhead. This month the brilliant star Capella is directly overhead. 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 climbing higher in the north east. Look for the distinctive saucepan shape, four stars forming the bowl and three stars forming the handle. Follow an imaginary line, up from the two stars in the bowl furthest from the handle. These will point the way to Polaris which will be to the north of overhead at about 50º above the northern horizon. Polaris is the only moderately bright star in a fairly empty patch of sky. When you have found Polaris turn completely around and you will be facing south. To use this chart, position yourself looking south and hold the chart above your eyes.

The planets observable this month are: Jupiter, Uranus and Neptune. Saturn and Venus are observable just before sunrise.