NEWBURY ASTRONOMY SOCIETY
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SPECTACULAR COMETS EXPECTED NEXT YEAR

Two new comets have been discovered that are predicted to be large and bright in our night sky during 2013. The first comet is called PAN-STARRS (C/2011 L4) and will reach is closest approach to the Sun in March 2013. At this time it is expected to be less than two million kilometres from the Sun. The second Comet known as C/2012 S1 (ISON) is expected to be at its closest on 28 November 2013. Some predictions suggest that C/2012 S1 will very bright at up to magnitude -16 that is brighter than the full Moon. If predictions hold true then the comet will be one of the greatest comets in human history. It should easily outshine the memorable Comet Hale-Bopp of 1997 and is very likely to be even brighter than C/2011 L4 which is also expected to be one of the brightest comets ever.

Comet Hale – Bopp imaged by Lee Mcdonald in 1997

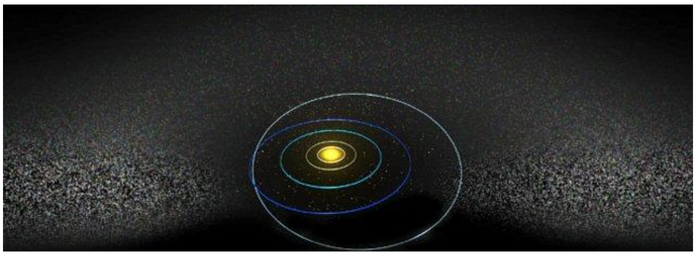
Comet C/2012 S1 (ISON) was found by the International Scientific Optical Network (ISON) in Russia on 21st September. The comet has a near-parabolic orbit suggesting it has arrived fresh from the Oort Cloud (see the next column). This means the comet is a pristine remnant from the formation of the Solar System. It will have lots of volatile gases in its composition which will melt readily as the comet moves closer to the Sun.

C/2012 S1 (ISON) was found in the north western corner of the constellation of Cancer. At magnitude +18 it is too faint to be seen visually but it will be within the reach of experienced amateur astronomers using CCD imaging equipment in the coming months as it brightens. It is expected to reach binocular visibility by late summer 2013 and will be a naked eye object in early November. Observers in the northern hemisphere are highly favoured and we in the UK are expected to have a spectacular view of the comet. Following its peak brightness in late November 2013 it will remain visible without optical aid until mid-January 2014.

Comet brightness predictions sometimes exceed their actual performance. Amateur astronomers of a certain age may remember the Comet Kohoutek hype of 1973 – not quite the 'damp squib' it has been portrayed, since it did reach naked eye visibility! Even if C/2012 S1 (ISON) only takes on the same light curve as Kohoutek it is certain to be spectacular, quite possibly a once-in-a-civilisation's-lifetime event.

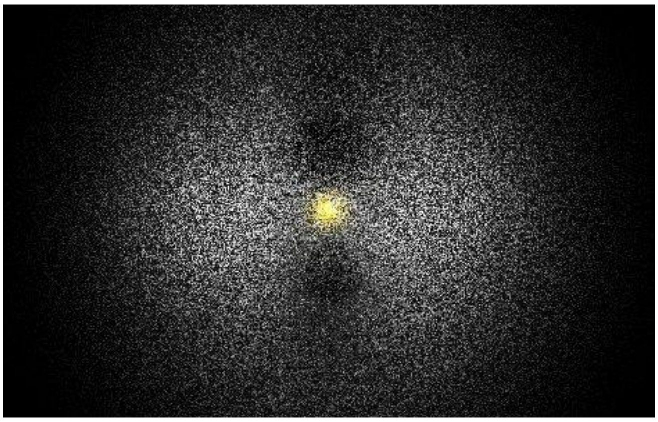
There are millions of comets and these 'dirty snowballs' are just floating through space on the edge of the domain of the Sun. Occasionally one may be disturbed perhaps when it has a close encounter with another comet. One or both may then be nudged out of its normal orbital path. If the nudge changes its direction so that it moves inwards towards the centre of the solar system the gravity of the Sun will begin to pull it in.

The nucleus of a comet is a lump of mainly water ice mixed with frozen gases and dust particles. Comets originate in a region beyond the orbits of the planets called the Kuiper Belt.



The Kuiper Belt beyond the orbit of the planets

Beyond the Kuiper Belt is a huge halo of comets. It surrounds the Solar System and has a radius of about 2 light years.



The Oort Cloud stretches half way to the nearest stars

As the comet gets closer to the Sun, its surface is warmed by the heat of the Sun and it begins to melt. As the ice melts it begins to form a halo around the comet nucleus, we call this the 'Coma'. The nucleus is typically about 20 kilometres across but the halo may be millions of kilometres across. Sun light is reflected off the coma and the comet becomes visible from Earth. As the comet moves ever closer to the Sun the radiation from the Sun begins to push against the coma and drive the light gases away and a tail begins to form.

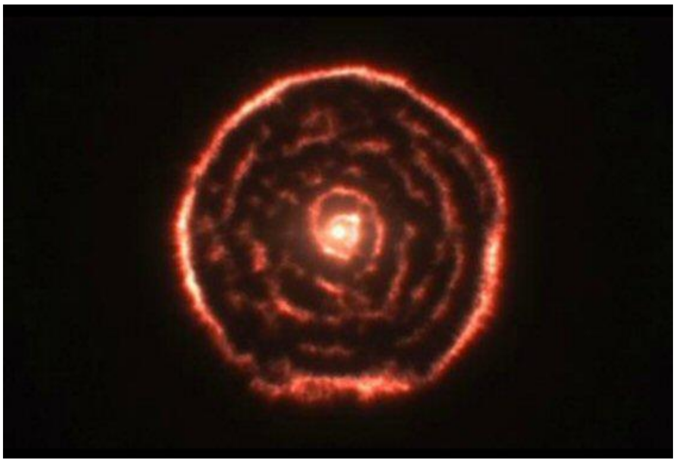
Often two or more tails may form, one is ionised gas that is easily blown away by the solar radiation (wind) and a second tail composed of heavier particles and non-ionised gases. The tail may become enormous and stretch back hundreds of millions of kilometres from the nucleus. The ion tail will always point away from the Sun regardless of the direction that the nucleus is travelling but the heavier tail may form an arc.

RED GIANT STAR SHOWS OFF ITS BEAUTIFUL SPIRAL STRUCTURE

Astronomers using the Atacama Large Millimetre/sub-millimetre Array (ALMA) have discovered a totally unexpected spiral structure in the material around an old star known as R Sculptoris. This is the first time that such a structure, along with an outer spherical shell, has been found around a red giant star. It is also the first time that astronomers could get full three-dimensional information about such a spiral. The strange shape was probably created by a hidden companion star orbiting the red giant. This work is one of the first ALMA early science results to be published.

A Red Giant is a star that has spent most of its life(typically 5 to 10 billion years) fusing Hydrogen into Helium and shining much the same way as our Sun is doing now. When stars like our Sun and those up to about three times the size of our Sun have used up most of their Hydrogen fuel they can begin to fuse some of the Helium they have created. This causes the star to heat up and begin to expand into a Red Giant. They increase in size until their radius is about the size of the orbit of Earth around the Sun.

A team using the ALMA array, the most powerful millimetre/sub-millimetre telescope in the world, has discovered a surprising spiral structure in the gas around the red giant star R Sculptoris. This means that there is probably a previously unseen companion star orbiting the star. The astronomers were also surprised to find that far more material than expected had been ejected by the red giant.



R Sculptoris imaged by the ALMA Array

Shells have been seen around this kind of star before but this is the first time a spiral of material coming out from a star has been seen together with a surrounding shell. As gas and dust is blown away from the star the expanding shell of material becomes the familiar shape of a Planetary Nebula.

Because they blow out large amounts of material red giants like R Sculptoris are major contributors to the dust and gas that provide the bulk of the raw materials for the formation of future generations of stars. These have planetary systems, with some planets comprised of rock and Iron like our Earth. These may even subsequently host life.

Even in this early Science phase, when the new observations were made, ALMA greatly outperformed other sub-millimetre observatories. Earlier observations had clearly shown a spherical shell around R Sculptoris but the spiral structure or the companion was not found.

When the star R Sculptoris was observed with ALMA, not even half of the planned antennas were in place. It is exciting to imagine what the full ALMA array will be able to do once it is completed in 2013.

Late in the lives of stars with masses up to eight times that of the Sun become red giants lose a large amount of their mass in a dense stellar wind. During the red giant stage stars also periodically undergo thermal pulses. These are short-lived phases of explosive helium burning in a shell around the stellar core. A thermal pulse leads to large amounts of extra material being blown off the surface of the star. This results in the formation of a large shell of dust and gas expanding out around the star. After the pulse the rate at which the star loses mass falls again to its normal value.

A wide field view of R Sculptoris

Thermal pulses occur approximately every 10,000 to 50,000 years and last only a few hundred years. The new observations of R Sculptoris show that it suffered a thermal pulse event about 1800 years ago that lasted for about 200 years. The companion star shaped the wind from R Sculptoris into the spiral structure.

By taking advantage of the power of ALMA to see fine details astronomers can better understand what happens to the star before, during and after the thermal pulse. Also the process of how the shell and the spiral structure were formed can be studied. The astronomers always expected ALMA to provide them with a new view of the Universe. However to be discovering unexpected new things already, with one of the first sets of observations, was unexpected and has been truly exciting.

In order to explain the observed structure around R Sculptoris, the team of astronomers has also performed computer simulations to follow the evolution of a binary system. These models fit the new ALMA observations very well.

It is now a real challenge to describe theoretically all the observed details coming from ALMA. These computer models show that the astronomers are really are on the right track. ALMA is giving them a new insight into what's happening in these stars and what might happen to our Sun in a few billion years from now.

In the near future, when the ALMA array is complete, observations of stars like R Sculptoris will help us to understand how the elements we are made up of reached places like the Earth. The observations and studies will also give us a hint of what the future of our own star might be. Our Sun is expected to start developing into a red giant in about 4 billion years time. Unfortunately if any humans are left on Earth they will not be able to witness the whole process. As the Sun begins to grow it will also produce more energy and heat. This will boil the seas and rapidly strip off Earth’s atmosphere making it uninhabitable.

NEW ASTEROID IMPACT SEEN ON JUPITER

Jupiter is a major player in protecting the Earth from impact events and has been for billions of years. Between comets and asteroids impacting on Jupiter and being flung into the Sun or out of the Solar System entirely, Jupiter's enormous gravitational field has removed the greater proportion of debris left-over from the formation of the Solar System. Jupiter has again been caught in the act of attracting and eating dangerous space rocks this time in simultaneous observations by two amateur astronomers.

The impact rate has been reasonably steady since the end of the Late Heavy Bombardment (LHB, about 3.8 to 4.1 billion years ago). The lower rate having been caused by Jupiter migrating slowly outward until it reached its present orbit. The kinetic energy and momentum it lost was largely transferred to the asteroids, most of which were no longer a factor in the Solar System at that point. We still receive an extinction-level impact (15-20 km) about every 100 million years, a civilization killer (2 km asteroid) every half million years or so and Tunguska/Meteor Crater rocks (50-100m) a few times per millennium but things could be a lot worse. Jupiter continues to sweep any material within its huge gravitational grasp mostly out of harm's way. (It occasionally sends a destabilised rock or comet in our general direction, but generally does more good than harm.)

We first saw Jupiter in the act of sweeping away dangerous material in 1979, when a series of Voyager I images of Jupiter showed a streak of light that lasted only a very short period. The streak showed structure consistent with an asteroid entering the Jovian atmosphere and then exploding when it reached dense enough material. There wasn't enough information from Voyager's instrumentation data archaic (from our point of view) to determine a size or impact velocity only that an asteroid had hit the surface of Jupiter.

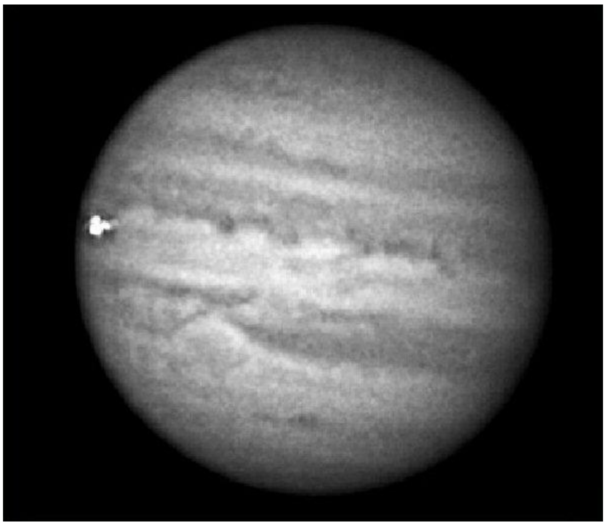
Shoemaker-Levy fragments impacting Jupiter

The next certain Jovian impact was in 1994 and was the most impressive. The collision of Comet Shoemaker-Levy 9 or rather 21 visible fragments of this comet ranging in size from about 2 km to a few hundred meters. The largest of the impacts had an energy equivalent to six million mega-tonnes of TNT which left a dark scar on Jupiter's surface almost the size of the Earth that persisted for many months.

Since 1994 there have been observations of four asteroid impacts or rather of three and the scar from an unseen impact. All of these have occurred since 2009, owing to the rapid advance in amateur astronomical equipment. As each of these was initially discovered by amateurs. In 2009 Australian Anthony Wesley noticed the dark scar of an asteroid impact near the south pole of Jupiter and caught it with a webcam attached to a large but not unusual amateur telescope. Later studies of the impact site by the Hubble Space Telescope provided convincing evidence that the impactor had been an asteroid and not a comet. The Shoemaker-Levy 9 impact observations were instrumental in their analysis.

There followed two smaller impacts in 2010 and the latest impact on 10th September 2012. The June 3, 2010 impact event was again discovered and photographed by Anthony Wesley who apparently makes a habit of being prepared for luck. This impact was too small to form a scar but from analysis of the brightness it appears that the impactor was perhaps 8-13 metres in size. On 20th August of that same year, three Japanese amateurs co-observed a new impact flash just north of Jupiter's northern equatorial belt. This impact also did not leave a scar and was a bit fainter than the June impact and was probably about ten metres in size.

The current impact event was seen very early in the morning on 10th September 2012. It was witnessed independently by two amateur astronomers. Dan Petersen of Racine, Wisconsin USA saw the flash visually and promptly posted his observation online in an attempt to find confirmation. (A single visual observation of a transient event is unlikely to be accepted by the astronomical community.) George Hall of Dallas, Texas had serendipitously been taking a video of Jupiter at the time of Petersen's observation. He checked his video frames for that interval. Sure enough he had taken a clear video of the impact event. The picture below is a still from that video.

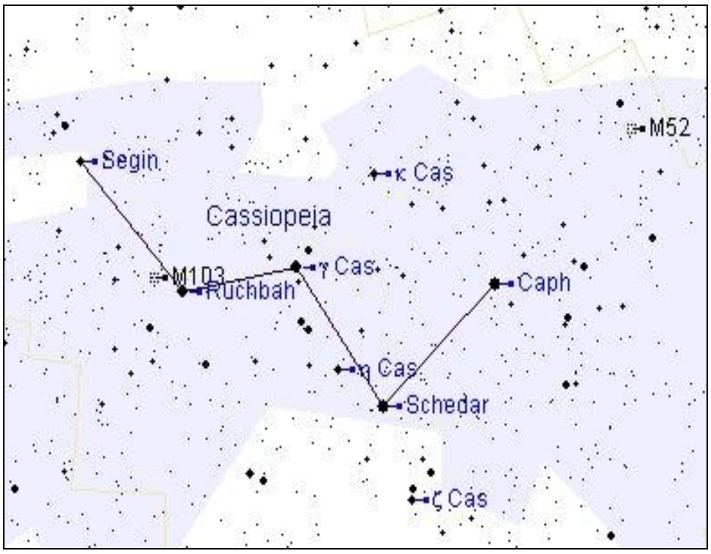


Jupiter hit by a 5 – 10 metre Asteroid - image G. Hall

Again no scar was formed on the surface. However, astronomer Mike Wong of the University of California at Berkeley has performed an analysis of the impact flash and finds that the total impact energy was roughly 0.14 petajoules. The equivalent of 30 kilo-tonnes of TNT. As the typical impact velocity on Jupiter is larger than that on Earth (owing to Jupiter's greater gravity) the size of the impactor was an estimated five metres in diameter.

TWO CONSTELLATIONS THIS MONTH

THE CONSTELLATION OF CASSIOPEIA

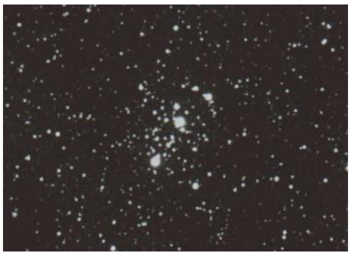


Cassiopeia is one of the most recognisable constellations and is almost directly overhead at this time. The stars that form the distinctive 'W' shape are bright and make the pattern stand out very well even though the constellation is located in the Milky Way. If binoculars are used to sweep through Cassiopeia what looks like clouds of stars can be seen. These are the stars in the arms of our galaxy 'The Milky Way'.

Cassiopeia is circumpolar this means it is always visible in a clear night sky because it does not set below the horizon. It is also useful for finding the North star (or Pole Star) Polaris in the constellation of Ursa Minor. Cassiopeia is located almost directly opposite Polaris from Ursa Major (The Great Bear or Plough). By using the central 'Λ' of the 'W' as a pointer the direction passes through the Pole Star and on to Ursa Major. If the Pole Star cannot be found on the way to Ursa Major then the two pointer stars of the saucepan shape of Ursa Major can be used to find it. As Cassiopeia is almost directly overhead at this time of the year it can be used to find Ursa Major that will be hovering over the northern horizon for most of the winter.

There are two Messier Open Clusters in Cassiopeia, M52 and M103.

M52



M103

Both of these open clusters are within the reach of binoculars and will appear as small fuzzy spots. A telescope will resolve the M52 cluster enabling most of its 150 individual stars to be made out. The stars are very young and may even be younger that those in the Pleiades in Taurus. M103 was a late addition to Charles Messier's catalogue and wasn't even discovered by Messier. The cluster is slightly smaller and fainter than M52 but is still easy to find using binoculars. There are a couple of small satellite galaxies of M31 (see the next column) in Cassiopeia but these will need a medium sized telescope to find.

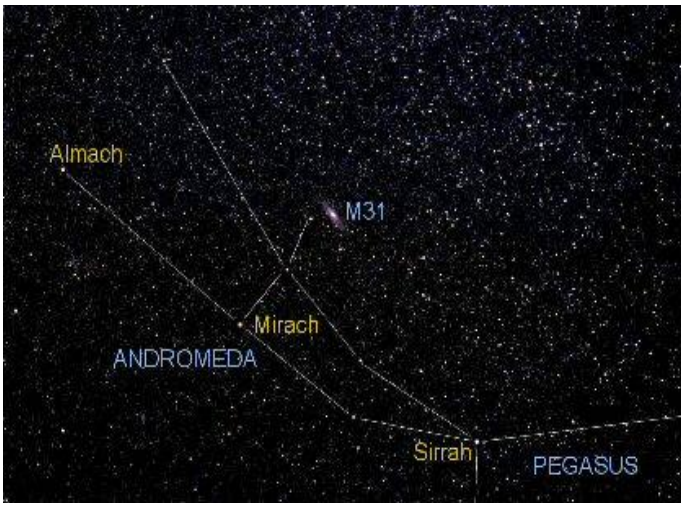
THE CONSTELLATION OF ANDROMEDA

The constellation of Andromeda is quite easy to find on a clear dark night high in the south. See the charts on pages 6 and 8. We can use the quite obvious 'Square of Pegasus' to lead us on to Andromeda. Once the 'Great Square of Pegasus' is found the pointer to Andromeda is the top left star of the square which is named Sirrah or alternatively Alpheratz. Strangely Sirrah (Alpheratz) is officially not part of Pegasus but the first and brightest member of Andromeda and designated as Alpha (α) Andromedae.

From Sirrah (Alpheratz) follow the rather obvious lower line of stars to the left (east). Locate the second star in the line which is shown as Mirach on the chart below. From Mirach follow a slightly fainter line of stars to the north (above) Mirach to the second star. Just to the right of this star is the faint fuzzy patch of light this is M31 the Great Andromeda Galaxy.

M31 can be seen from the UK as a small fuzzy patch of light but does need a dark clear sky. It is quite easy to find using binoculars and is well place at this time of year. The easiest way to find M31 is to first locate the Great Square of Pegasus.

The image below gives an approximate naked eye view of M31 in Andromeda although somewhat clearer than can be hoped to be seen with the naked eye and there are many more stars. However a pair of binoculars will enable the galaxy to be seen easily. A small telescope will show an elongated oval shaped hazy patch with a brighter spot in the middle.



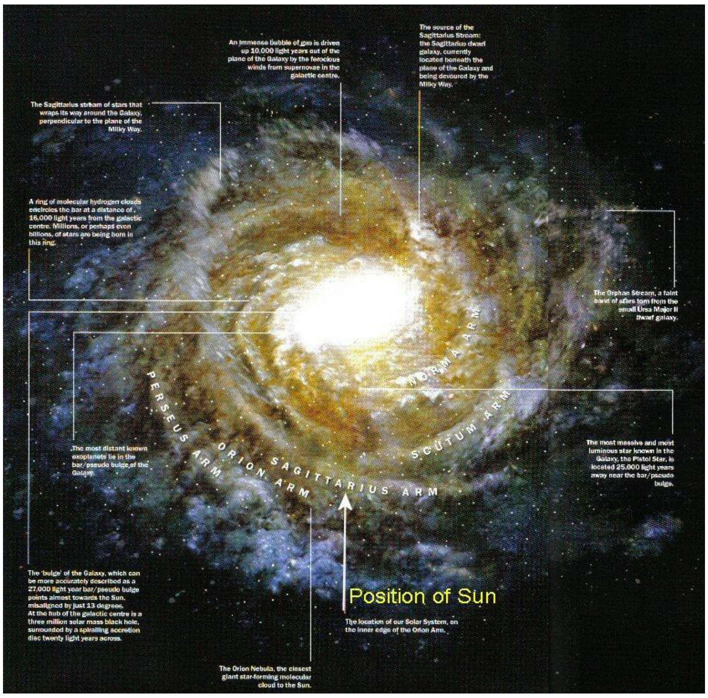
The position of M31 in Andromeda

M31 is a large spiral galaxy tilted almost edge on to our point of view but even at this angle the spiral arms can be seen in photographic images. Our Milky Way galaxy is estimated to be around 100,000 light years in diameter but M31 is larger at about 170,000 light years across. M31 is so far away that its light takes in excess of 2¼ million years to reach us. This makes it the most distant object that can be seen with the naked eye. It is also speeding towards us and will collide with our Milky Way galaxy in about five billion years time.

The star at the end of the lower line of stars in Andromeda is called Almach and is a beautiful double star. One star is golden and the other is blue. The pair can be seen in a small telescope and the closeness of the pair shows off the colours.

Galaxies are the largest formations or groups of individual stars that we know. All the stars we see in the night sky are part of a huge family of stars that form our galaxy which we call the Milky Way or 'the Galaxy' (with a capital 'G'). We see the nearest stars to us as individual stars but as we look at those further away they tend to merge into the fuzzy glow of the Milky Way. This effect is rather like standing in a pine wood. The trees nearest to us are seen as individuals but in the distance they merge into just a solid mass of trees.

Our galaxy forms part of what is known as the 'local group' of galaxies comprised of about 30 members. The local group is dominated by two large spiral type galaxies: ours (the Milky Way and M31 the Great Galaxy in the Constellation of Andromeda.



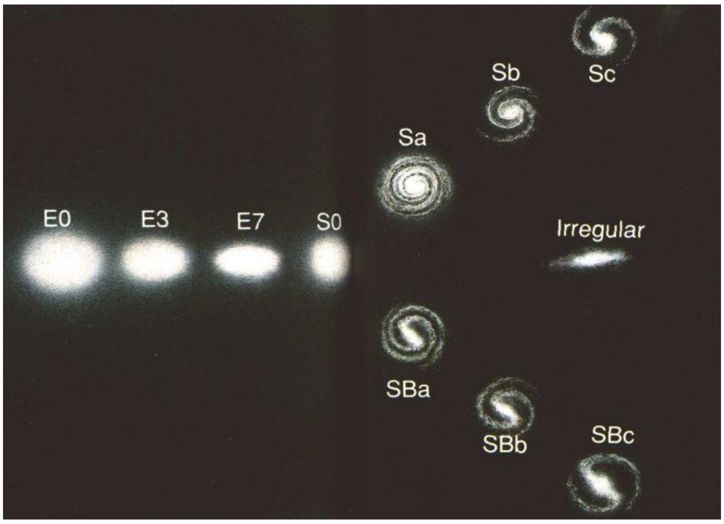
An artist's impression of the position of our Sun (arrowed)

The Milky Way has more than 200 billion stars and the Andromeda galaxy is about twice the size with about 400 billion stars. All the other members of the local group are smaller and many are located like satellites around the two large spirals.

M31 The Great Spiral Galaxy in Andromeda

As amazing as it seems there are clusters of galaxies and even super clusters of clusters of galaxies. Billions of galaxies can be seen stretching out into the universe as far as our most powerful telescopes can see.

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

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, some having thousands of billions 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. There are some indications that giant elliptical galaxies grew from the collision of two or more smaller galaxies. There are indeed some galaxies that can be seen in the process of colliding and combining.

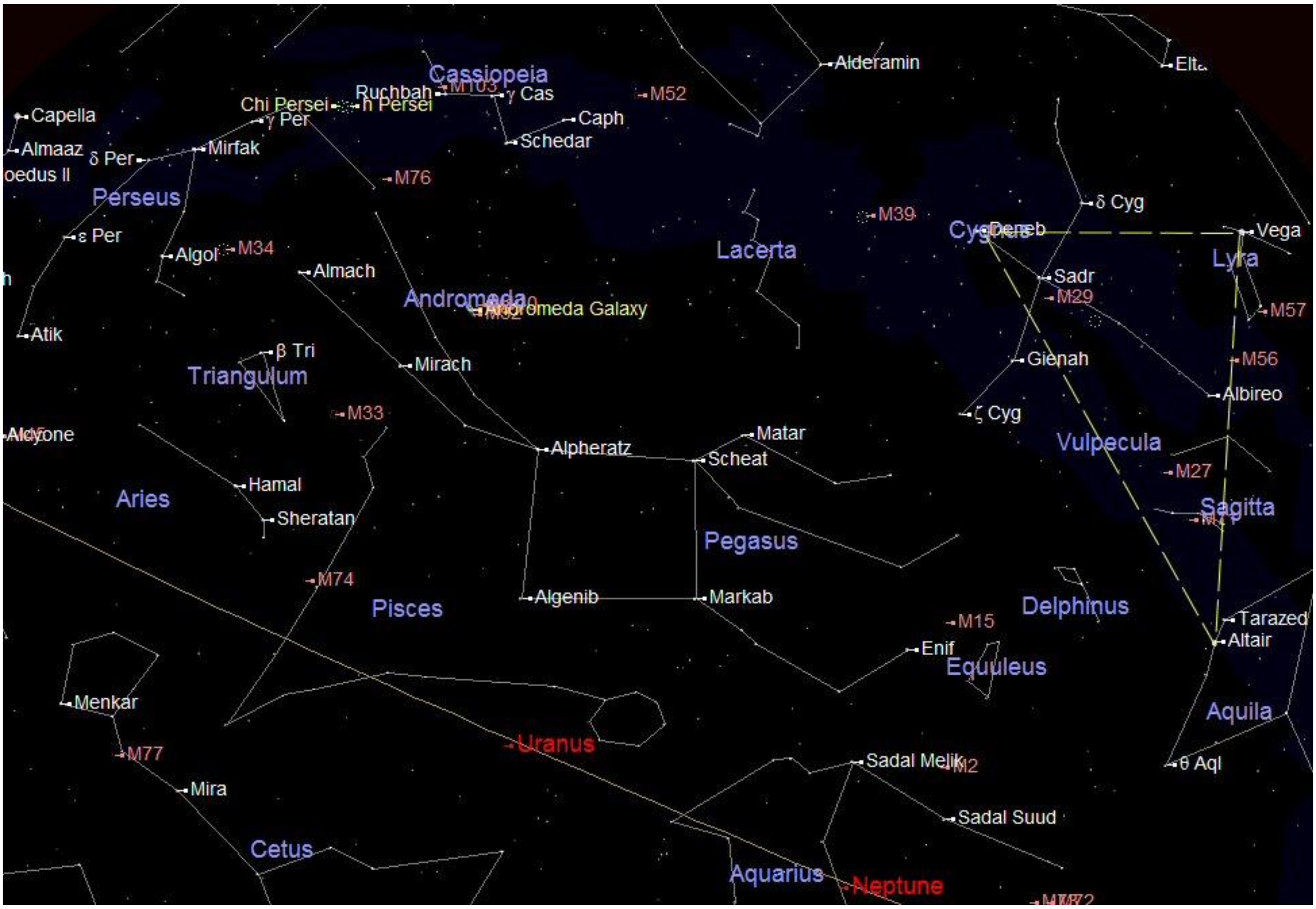
IRREGULAR GALAXIES

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

SPIRAL GALAXIES

Like our galaxy the Milky Way, many galaxies have spiral arms. Some have arms like curved spokes in a wheel, some gently curved, some tightly wrapped around the central ball. Others have what looks like a straight bar of stars extending out from the central bulge with the spiral arms attached to ends of the bar, these are the Barred Spiral Galaxies. The 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 Andromeda Galaxy is our closest spiral neighbour and can even be seen with the naked eye on a very clear night and from a dark location.

EXPLORING THE NIGHT SKY THIS MONTH



The chart above shows the southern sky at about 20:00 (8 o'clock) around the middle of November. At the beginning of the month the positions of the stars will be a little further to the left (east) and at the end of the month they will be further to the right (west).

The Summer Triangle (comprised of Deneb, Vega and Altair) has now moved closer to the western horizon so is to the right (west) of the chart. However it will still be well positioned high in the south earlier in the evening as soon as it is dark.

To move on to the late autumn constellations we must move to the east (left) from the Summer Triangle. Moving to the east from Deneb (the upper left star of the Summer Triangle) we move into the rather faint and quite visually boring constellation of Lacerta. Almost directly over head is the obvious 'W' shape of Cassiopeia which can be seen at the top of the chart and slightly to the left of centre. Five bright stars mark out the ends and the points of the 'W' shape. These stars are named Segin(ε), Ruchbah(δ), γ (gamma)Cas, Schedar(α) and Caph(β).

To the east of Cassiopeia is a fairly obvious line of stars that constitute the constellation of Perseus which is shown at the top left of the chart above. In this line of stars is a beautiful object that can be seen quite easily through binoculars. This is the famous Double Cluster which is marked as Chi Persei and h Persei in the top left corner of the chart above. The Double Cluster appears to be a pair of Open Clusters that might have formed from the same nebula (cloud of gas and dust). On a good clear night and away from lights it can even be seen with the naked eye as a hazy patch.

Some way south of Cassiopeia is the Great Square of Pegasus (the Flying Horse). It is very noticeable in the lower part of the chart above but is a little more difficult to identify for the first time in the night sky. It is bigger than may be expected but once identified is much easier to find again. The Great Square of Pegasus is marked by the four stars Alpheratz, Scheat, Markab and Algenib however Alpheratz (sometimes called Sirrah) is not officially part of Pegasus.

Alpheratz (the top left star of Pegasus) is in fact the first and brightest star in the constellation of Andromeda and has the official designation α (alpha) Andromeda.

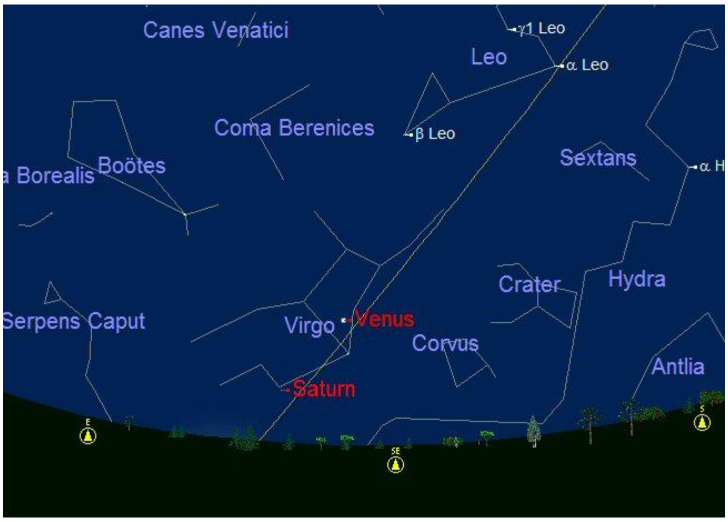
The constellation of Andromeda is joined to the Square of Pegasus at the star Alpheratz and is comprised of two lines of moderately bright stars that diverge away to the north east of Alpheratz. The brightest of all the galaxies (except our own galaxy, the Milky Way) is found in Andromeda.

To find the Great Andromeda Galaxy, known as Messier 31 (M31) start at Alpheratz. Follow the lower line of stars that form Andromeda to the second star called Mirach. From Mirach move up to the star in the upper line then on an equal distance to a second star. Just to the right of this second star is a fuzzy patch of light, this is M31. M31 can be seen with the unaided eye on a good clear night but is quite obvious when seen through binoculars. A telescope will show the bright central region and the fuzzy flat oval form of the spiral arms surrounding it (see pages 4 and 5).

THE SOLAR SYSTEM THIS MONTH

MERCURY is too low and will not be observable this month.

VENUS is an early morning object this month and for the next couple of months. It rises over the eastern horizon at 03:45 at the beginning of the month, 04:14 mid-month and 04:45 by the end of the month. Venus will be reasonably high above the horizon in the south east by sunrise and in a good position for the early morning observer in the constellation of Virgo. It will appear about 85% gibbous (almost full Moon shaped).



Venus in the south east at 06:00 GMT (6 o'clock am)

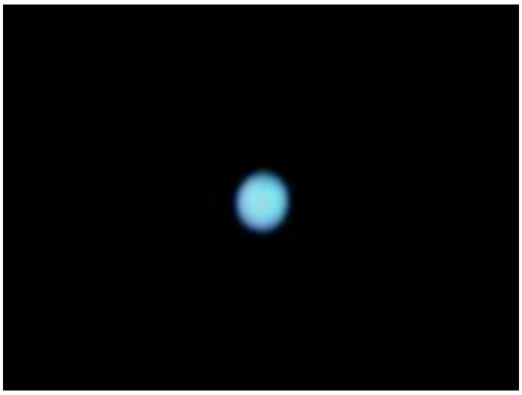
MARS has moved well away from Earth now and appears very small even in a large telescope. It may just visible very low in the south west, in the constellation of Libra, as the sky darkens.

JUPITER rises at 17:48 at the beginning of the month, 17:05 mid-month and 16:20 by the end of the month. It will be in a reasonable position for observing in the east an hour after it rises but will not be at its best for at least two hours after it has risen. It is now an evening object located in the constellation of Taurus. It is well worth looking out for even with a pair of binoculars. The four brightest moons can be seen moving around the planet. Sometimes it is possible to watch as the moons appear and disappear behind or pass in front of Jupiter. If you are very lucky you may even see an asteroid hit Jupiter as happened to amateur astronomer Dan Petersen on 10th September 2012 or even manage to image the event like George Hall (see page 3).

Jupiter close to the Moon on 3rd October 2012

SATURN has emerged from behind the Sun but is too low and too close to the Sun to be observed. See the Venus chart opposite.

URANUS is in its best position for observation this month. It rises in the east at about 14:30 and will be observable as soon as it is dark. Uranus is located on the border between Cetus and Pisces. It is quite low but should appear as a 'fuzzy' blue star in a 100mm refractor or a 150mm reflecting telescope.



Uranus imaged by Kyle Edwards

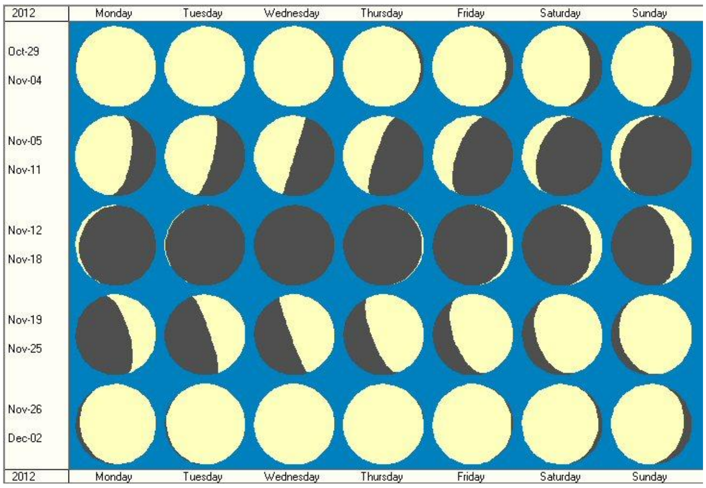
NEPTUNE Is observable as soon as it is dark in the constellation of Aquarius. It will look rather like a smaller and fainter version of Uranus.

THE SUN

Rises at 07:00 and sets by 16:30 at the beginning of the month and rises at 07:35 and sets at 16:00 by the end of the month. However it will not be fully dark until about one and a half hours after these setting times. The Sun remains quite active with many Sun spots and spectacular prominences.

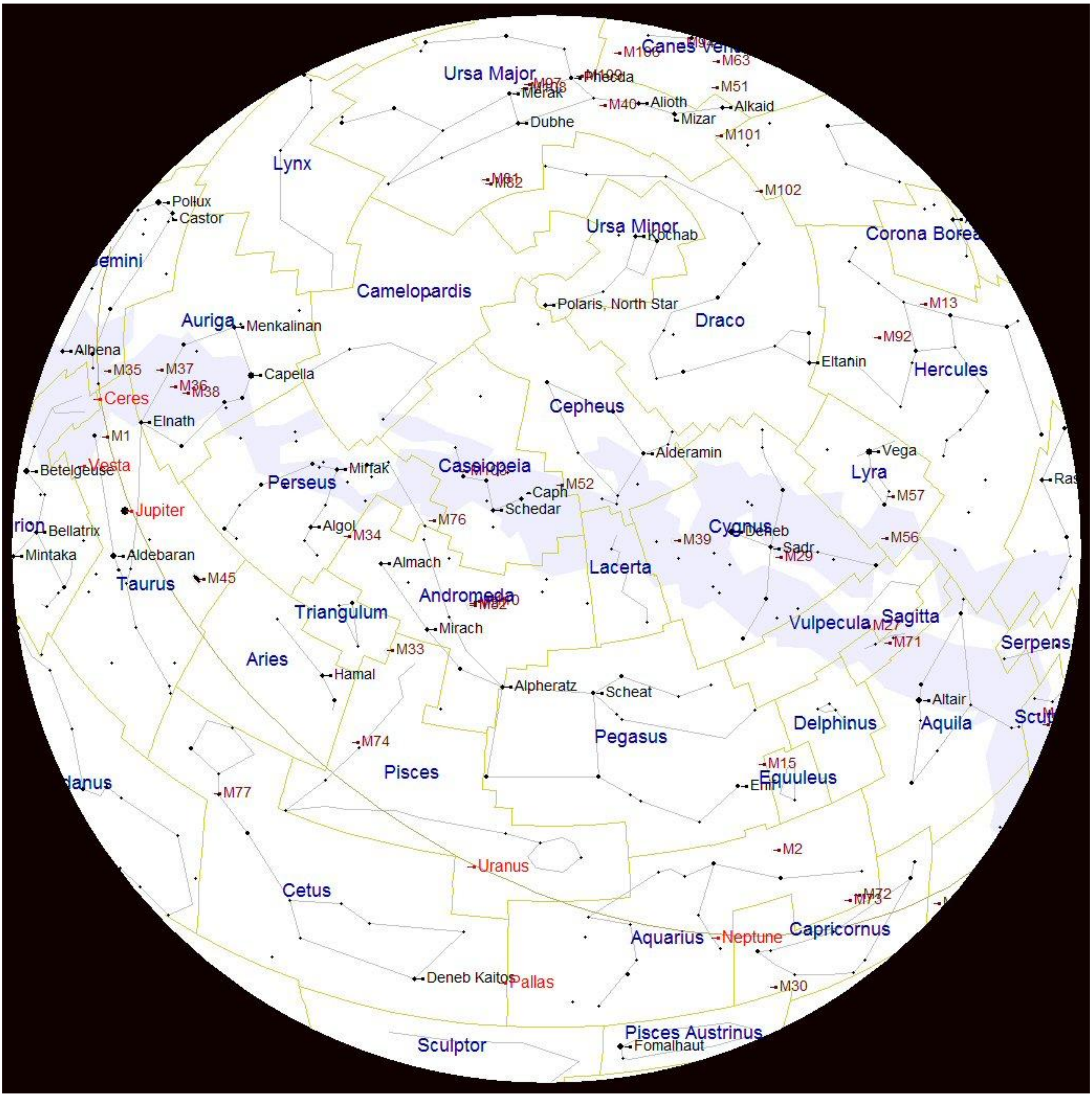
To see what is happening on our closest star in real time visit the website for the Solar and Heliospheric Observatory (SOHO) at http://soho.nascom.nasa.gov/. This is NASA's space observatory that has instruments continuously watching the activity on the surface of the Sun.

THE MOON PHASES THIS MONTH



The best views of the Moon are obtained when it is not full and the terminator is crossing the surface so the best times to observe it are: 2nd – 11th and 16th – 25th.

THE NIGHT SKY THIS MONTH



The chart above shows the night sky as it appears on 15th November at 8 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 9 o'clock GMT at the beginning of the month and at 7 o'clock GMT at the end of the month. The stars also appear to move 15º (360º divided by 24) each hour from east to west, due to the Earth rotating once every 24 hours.

The centre of the chart will be the position in the sky directly overhead, called the Zenith. First we need to find some familiar objects so we can get our bearings. The Pole Star **Polaris** can be easily found by first finding the familiar shape of the Great Bear 'Ursa Major' that is also sometimes called the Plough or even the Big Dipper by the Americans. Ursa Major is visible throughout the year from Britain and is always quite easy to find. This month it is to the west of 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.