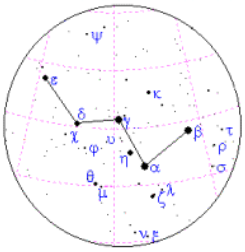


Wadhurst Astronomical Society Newsletter June 2018

MEETINGS

MAY MEETING

Phil Berry, who after outlining the evening's programme, welcomed back Colin Stuart to give tonight's talk.

Colin is an author of a number of books on astronomy and has given talks to over a third of a million people. He has sold over 100,000 books and also writes for a number of newspapers and periodicals and even has an asteroid named after him in recognition for his work to popularise astronomy.

How to Weigh the Universe
Colin Stuart FRAS

Colin always begins his talks with something unexpected and this was no exception. He compared life on Earth to life in TV's "Bake Off" tent; a lot is going on inside that we know about but not a lot is known about outside. The physical rules inside the tent appear to be the same as those on the outside of the tent. It is the same on the Earth. But then we begin to explore further using anything we can such as telescopes, sending off astronauts out into space, and so on.

Colin spoke of Tycho Brahe, who, before the invention of the telescope, was so well known for his naked-eye astronomy and careful recording of his observations that the King of Denmark gave him an observatory. He had an assistant called Kepler who, following Brahe's death used those observations to form three mathematical laws. The first states that planets move in elliptical orbits. The second states that a line segment joining a planet to the Sun sweeps out equal areas during equal intervals of time, which means a planet speeds up when nearer the Sun.

The third law states that the square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit. So a planet closer to the Sun orbits more quickly than a more distant planet, and Colin showed us some of the calculations.

He said Kepler stated the laws but it was Isaac Newton who explained that the planets obeyed these laws because of gravity. We were told that once we know the time it takes to make one orbit and the distance from the Sun we could weigh the central object.

In theory, the Earth could be weighed using the Moon, but Colin said that the first thought of weighing the Earth was proposed by Isaac Newton. His idea was to use the deflection of a pendulum when brought close to a mountain in Scotland whose mass could be calculated because of its conical shape but concluded that it was too difficult. Nevil Maskelyne later decided to make the measurements and got to within 75% of the weight of the Earth, as we know it today. That was in 1774. But he also found that the Earth itself was much denser than the material of the mountain.

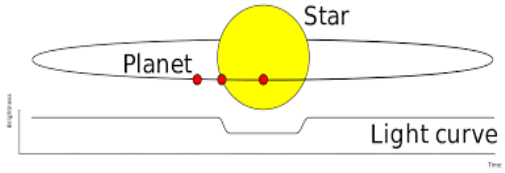
Schiehallion Mountain in Scotland used by Nevil Maskelyne to help measure the mass of the Earth in 1774

Colin said that once the mass of the Earth was known, it would now be possible to determine the mass of other stars and planets.

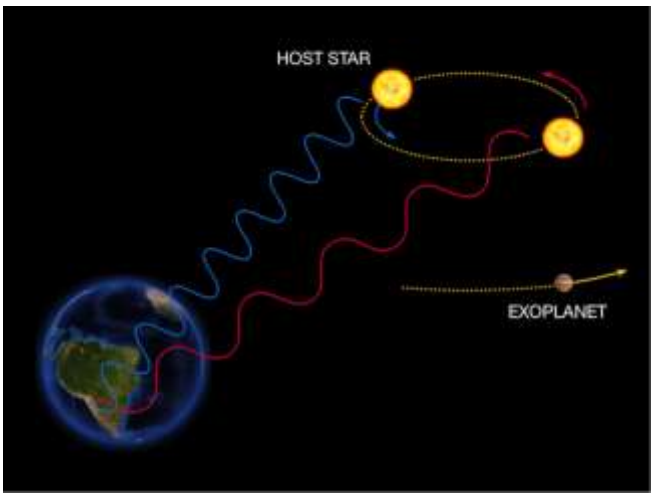
In 1780, Uranus was discovered and by testing Kepler's laws it was found that this planet didn't quite obey the rules. When the calculations were performed the result suggested there must be another planet in an orbit outside that of Uranus and eventually Neptune was discovered to within 1^{o} of where the calculations had predicted.

The Kepler Space Telescope is now discovering planets around stars other than the Sun. Colin described some ways in which we are able to detect these planets. The first method he talked about was the transit method whereby the light from a star dips very

slightly as the exoplanet transits across the star's surface. From these dips, a lot can be learnt about the planet. The size of the dip gives some idea of the size of the planet and the time between dips shows the time taken to orbit the star and once this is known, we have some idea how close to the star the orbit is and so whether the planet is going to be hot or not.



Graph of the light curve from a transiting exoplanet
Wikimedia



Graphic description of the red/blue spectral shift indicating the wobble of a star by an exoplanet

European Southern Observatory

We have an idea of the mass of the star from its absolute brightness but to be able to ascertain the mass of the planet we would need to know details of the orbit of a moon and as yet no moons around exoplanets have been found.

Another method of detecting exoplanets is to use the red/blue shift of the black lines in a star's spectrum. As a planet moves round a star, the two orbit around a common central axis and we were told that we can measure the wobble of the star, so determining the planet's orbit through the time between adjacent shifts.

At this point Colin described the difference between Newton's theory that light was bent by gravity and Einstein's theory that the presence of a large mass distorts space around it. In 1919 Arthur Eddington proved Einstein to be right when he was able to detect a star behind the Sun during a total-solar eclipse and found it to be in exactly the right position as opposed to where Newton's theory said it would be.

A black hole distorts space so much that even light would have to travel faster than the speed of light to escape its clutches.

The LIGO (**L**aser **I**nterferometer **G**ravitational-wave **O**bservatory) is an experiment to monitor the gravitational waves and Colin explained that it consisted of two laser beams being fired down two precise 4km long empty tubes at right angles to each other with mirrors at each end, returning the laser beams, which were then compared; any discrepancy indicating a distortion.

LIGO Detector at Livingstone, Louisiana

Caltech

In 2015 a momentary ripple was detected and it was found to have been caused by the very rapid combining of two black holes 1.3 billion light-years away. We were told that the difference in change of length between the two LIGO arms was in the order of the diameter of an atom's proton! Other gravitational-wave detectors are being built and it should be possible in future to triangulate the direction of the source

The suggestion that there is a black hole at the centre of the Milky Way has been followed by infrared observations of stars close to the centre of the galaxy and it has been found that these stars are orbiting very fast and calculations have revealed that there is something with 4-million solar-masses in a space no bigger than the distance between Mercury and the Sun.

Infrared image of the fast moving stars around the centre of the Milky Way

Stuart Rankin

In the 1930s, Jan Oort, discoverer of the Oort cloud, found that the stars on the edge of the Milky Way didn't obey Kepler's Laws and Colin said that about the same time Franz Zwicky was looking at other galaxies and found the outer stars were also going too fast and should have flown off into space. Zwicky proposed that perhaps there was something else in these galaxies holding the stars and he called it Dark Matter.

The case was taken up again In the 70s, and American astronomer Vera Rubin, also found this in the Andromeda galaxy and then in many more as well.

The evidence for Dark Matter was growing and perhaps this invisible mass was spread out through the galaxy rather than at the centre. If this is the case, then the answer would have to be that the mass of the galaxy is in fact twenty times what we see, where the visible galaxy is only 5% and the rest is invisible Dark Matter making up 95% of the mass.

So Dark Matter must be defined as dark and have gravity.

Finally, Colin talked about a theory called Supersymmetry where basic elementary particles each have a mirror image particle. An Electron would have a symmetrical particle called a Selectron , whilst a Quark, would have a Squark particle and so on and Dark Matter it is thought, might consist of the lighter of these particles. He went on to say that many different tests have been set up to detect these new particles but nothing has been found after many years of searching. Colin also went on to say that perhaps all this time we have been getting gravity wrong and we should be using Modified Newtonian Dynamics. (MOND)

This is where Colin ended his talk, leaving us with that open question.

Following the break, John Lutkin gave a short introduction to the General Data Protection Regulations

A brief outline of the General Data Protection Regulations
John Lutkin

John Wayte sadly was not well and was unable to give his usual Snippets from the World of Science, so John Lutkin gave a brief introduction to the General Data Protection Regulations, which came into effect on the 25th of May and how it affects the Society.

The Society keeps only the names, addresses, email addresses and some telephone numbers of members. All members will need to consent to us using this data. He said that members will be sent an email requesting their consent to use the data to send emails. If there is no response, the data will be removed from the Society's records and no more emails will be sent, although the newsletter will still be available on our website.

John said that the data is only used for membership payment records and for sending out the newsletter. Any data that is kept will need to be kept in an encrypted form.

Once anyone ceases to be a member, their data will be deleted completely.

Members have the right to know what data is being kept and be able to correct or update anything.

At no time will the Society use any personal data for any other purpose.

This is meant only as an introductory guide.

Brian Mills followed with the Sky Notes for June, which follow later in the newsletter.

THE SOCIETY'S VISIT TO THE RAS

On the 22nd of May, a number of us visited the library of the Royal Astronomical Society in London, arranged by our Chairman, Brian Mills, a Fellow of the RAS.

The rather unimposing entrance to the RAS is in Burlington House amongst a number of learned societies around the courtyard of the Royal Academy of Art on Piccadilly.

The Astronomical Society was formed in 1820 by 'gentlemen astronomers' rather than professionals and was intended to promote research. In 1831 it was granted a royal charter by William IV and so became the Royal Astronomical Society.

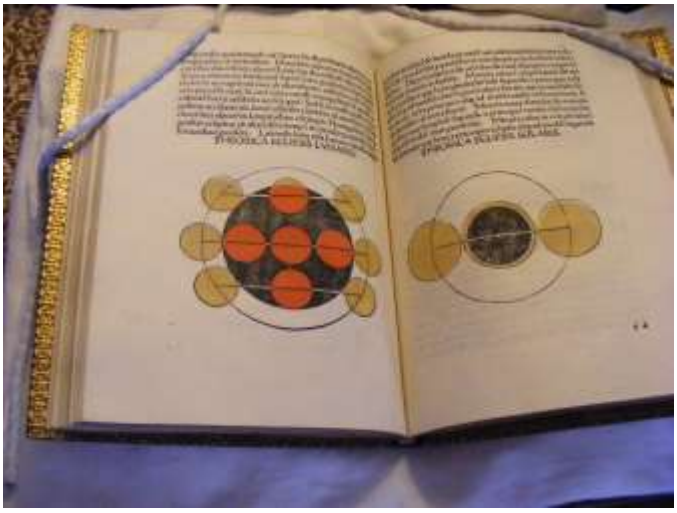
On entering, the noise of the street was left behind and we were in this wonderful old building seeped in history.

We were met by Librarian Archivist, Sian Prosser who took us up to the first floor and into library itself. The walls were completely lined with books covering all aspects of astronomy from early history to books and papers dealing with the most current research.

Visitors from WAS in the library of the Royal Astronomical Society

There were certain restrictions to be observed to protect the books, one being that only pencils were permitted; that was the end of my note taking even before we began.

The first book Sian showed us was one of the oldest books in the library. It was written in Latin by a medieval astronomer from the north of England but was printed in Venice in 1485 and then some of the drawings were hand painted in each copy. A number were printed and placed in universities round the world.



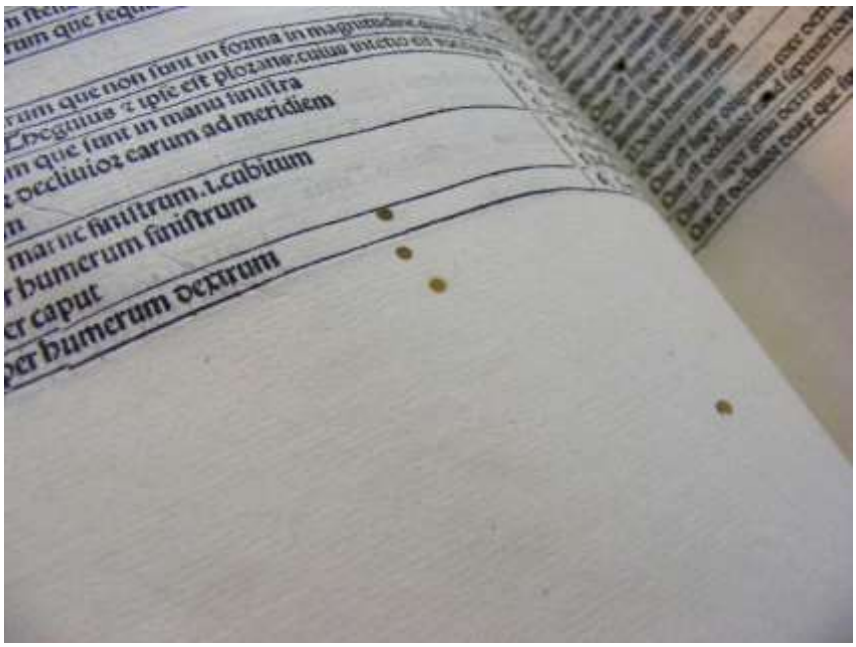
Book from 1485 by John of Holywood a medieval astronomer

Title page from an edition of Johannes Kepler's Urania Propitia

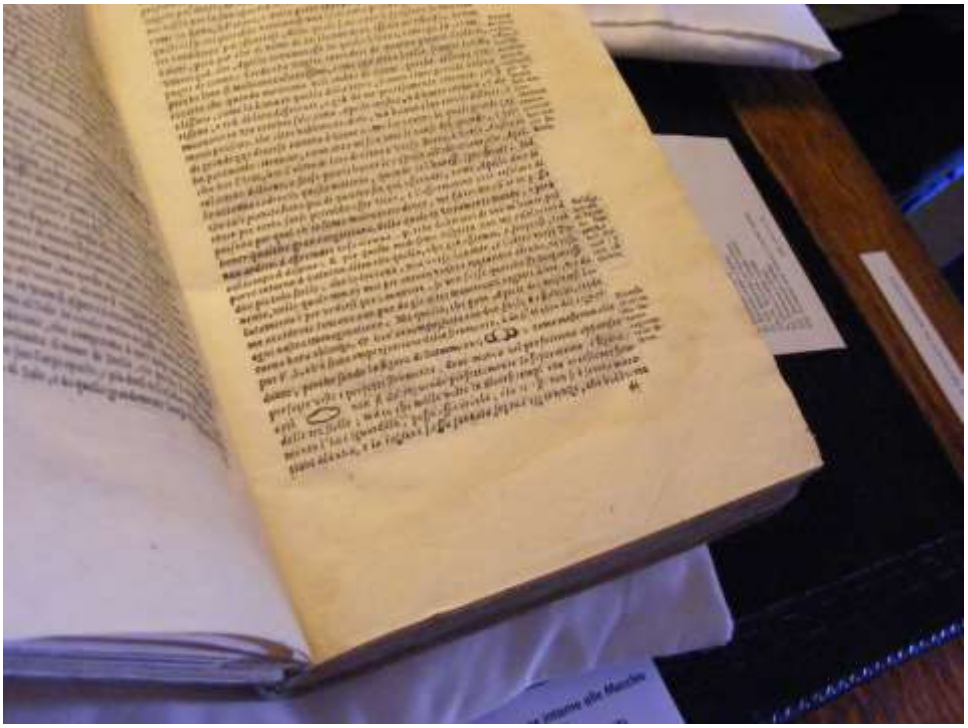
We were shown a volume written by Tycho Brahe, mentioned in Colin Stuart's talk earlier in the newsletter, which showed tables of his observations. Then we were able to see a beautifully bound book by Johannes Kepler and could see the original pages that included his three laws.

A book by Ptolomy dated 1515 revealed just how vulnerable these old books were when we were shown damage done by bookworms before the library developed new techniques to preserve them for the future.

An example showing bookworm damage to one of the books



The library also had a copy of a book written by Galileo showing some of his early interpretations of what he saw through his telescopes. In the book below, we could see his first impressions of what he saw looking at Saturn. At one time he thought the planet had ears.



A page in a book published by Galileo in 1613

We leapt forward a couple of hundred years to the books by William Herschel. These were his notebooks in his own neat handwriting with drawings of his observations. Some of the notes covered the discovery of Uranus from the time he recorded a 'comet' first seen on March 30th 1781 near the left foot of Castor. He soon realised that it wasn't a comet and began to refer to it as his planet.

These books are still under copyright and couldn't be photographed but Sian told us that the family were quite keen to have them digitised and made available online at some point.

Finally, Sian told of some of the other treasures held by the Society such as glass plates but preserving them was a great challenge to keep them in a temperature controlled environment.

This had been a very rare glimpse into the real history of astronomy with grateful thanks to Brian Mills for making the arrangements.

Geoff Rathbone

JUNE MEETING

20 June 2018 – Our Chairman, Brian Mills FRAS takes "SOFIA and Airborne Observing" as his subject.

Meetings will take place at Uplands College, Lower High Street, Wadhurst and are held in classrooms IL5 and IL6 which are in the blue walled classroom block at the far end of the drive from the main gate and up by the tennis courts. Signs will direct you. There is car parking near the block although this needs to be cleared before 2230 when the gates close. The postcode is TN5 6AZ.

Meetings begin at 1930 prompt although members are invited to arrive anytime after 1900, as this is a good time to exchange ideas and discuss problems and also help set things up before the meeting starts.

Anyone is welcome but non-members are asked if they wouldn't mind contributing £3 towards costs.

FUTURE MEETINGS

18 July 2018 – The highly entertaining Dr David Mannion tells us about "Astronomical Numbers".

There is no meeting in August

19 September 2018 – WAS member Will O'Brien talks on "Dynamics of Charged Particles in Planetary Magnetic Fields".

17 October 2018 – Dr Stephen Wilkins gives us the latest information about "Exploring the Universe with the James Webb Space Telescope"

21 November 2018 – Jan Drozd explains about "A Pale Blue Dot – Earth from an Aliens Perspective".

SKY NOTES FOR JUNE 2018

Planets

Mercury was at greatest western elongation on April 29th but this was a poor apparition as seen from the UK. The planet then arrives at superior conjunction (when it is on the opposite side of the Sun from the Earth) on June 6th and is therefore invisible for the first part of June. However, Mercury moves swiftly into the evening skies to appear very low down in the northwest. By the end of the month (as shown in fig 1) it is 5° in altitude when the Sun is 6° below the horizon. The planet will reach greatest elongation (E) on July 12th although its altitude will have declined by that time.

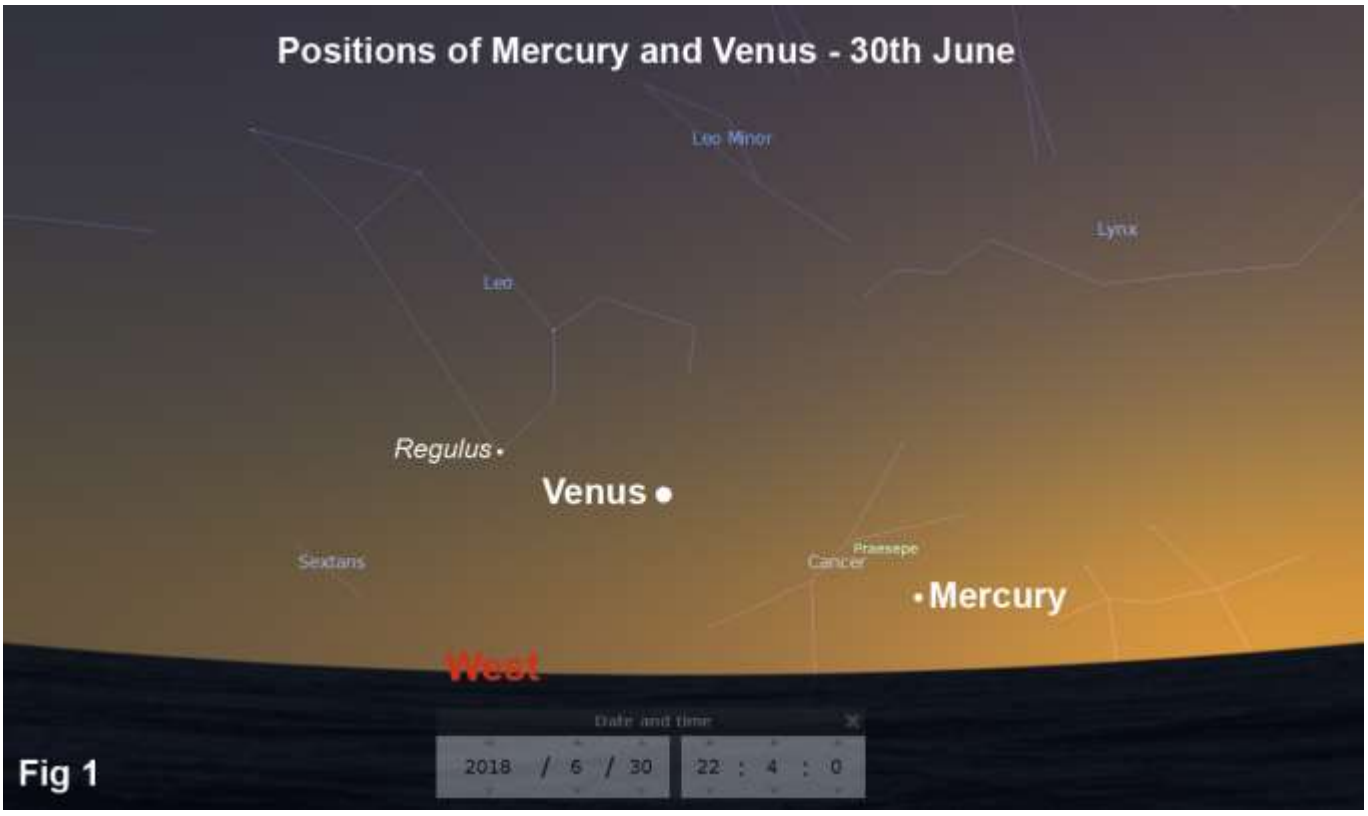


Fig 1

Venus is an obvious evening object in the west as soon as the Sun has set. On the first of the month it is almost 23° above the horizon and just a few degrees past due west at sunset shining at magnitude -4.0. It continues to brighten slightly as it moves closer to Earth and its apparent size increases although its phase (the percentage illuminated) decreases. The elongation of Venus (38° in the middle of the month) continues to increase although this tells only part of the story as far as the altitude, and therefore visibility, of the planet is concerned. As already mentioned, at the beginning of June the planet is nearly 23° above the horizon as the sun sets, by the 15th this has slipped a little to 21° and by the 30th it has dropped to a little under 19°. By the time of greatest elongation Venus will be only 10° high at sunset. Things only get worse as the days pass and by early October it will actually set *before* the Sun despite still being some 25° east of it. This is because Venus, by then, will be 22° below the celestial equator and 7° below the ecliptic.

Earth reaches the summer solstice on June 21st at 11:08 BST. At that moment in time the Sun has reached the most northerly declination possible and from then on it appears slightly lower in the sky on subsequent days. This means that imperceptibly, day by day, the hours of daylight are decreasing.

If you happened to be at the north pole on June 21st the Sun would be above the horizon all day (see fig 2) whereas if you were a little further south on the Arctic Circle (latitude 66.5° north) you would see the height of the Sun decrease until it skimmed the horizon at midnight.

Conversely, if you were on the Antarctic Circle (latitude 66.5° south) you would see the Sun graze along the horizon at midday but everywhere south of it would experience 24 hours of darkness.

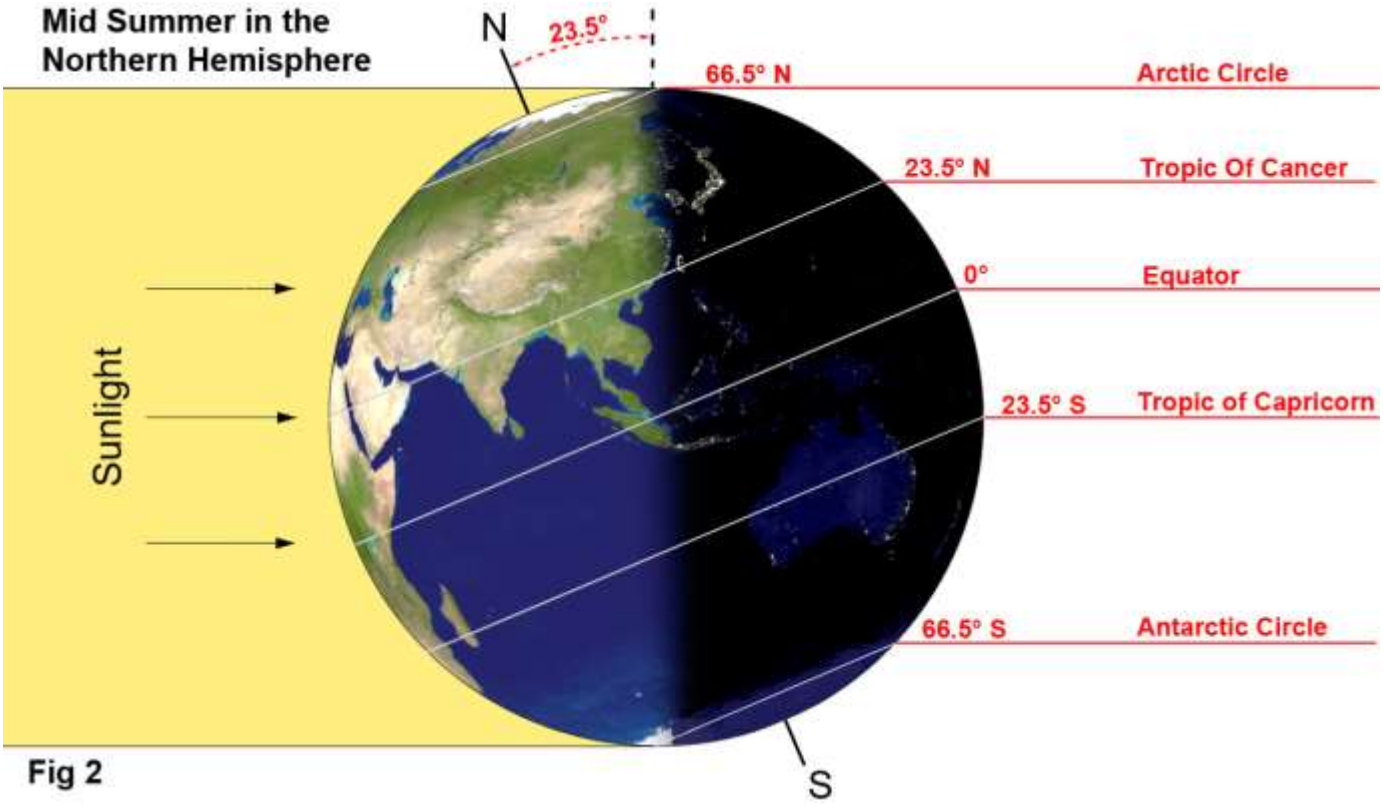


Fig 2

Mars is still a morning object and rises at 01:00 BST at the start of the month. On that date it is 16° in altitude at just after 04:00 when the Sun is 6° below the horizon (beginning of civil twilight). As the month progresses Mars rises a little earlier each night until by the end of June it is technically an evening object rising at a little after 23:00 although it will be 03:30 before it culminates at an altitude of just 16°. During June the planet's magnitude increases to -2.1 and its angular size grows to 20" (20 arc seconds). It spends the month in Capricornus and on the 28th it reaches its first stationary point after which it moves retrograde (east to west). Mars will reach opposition on July 27th.

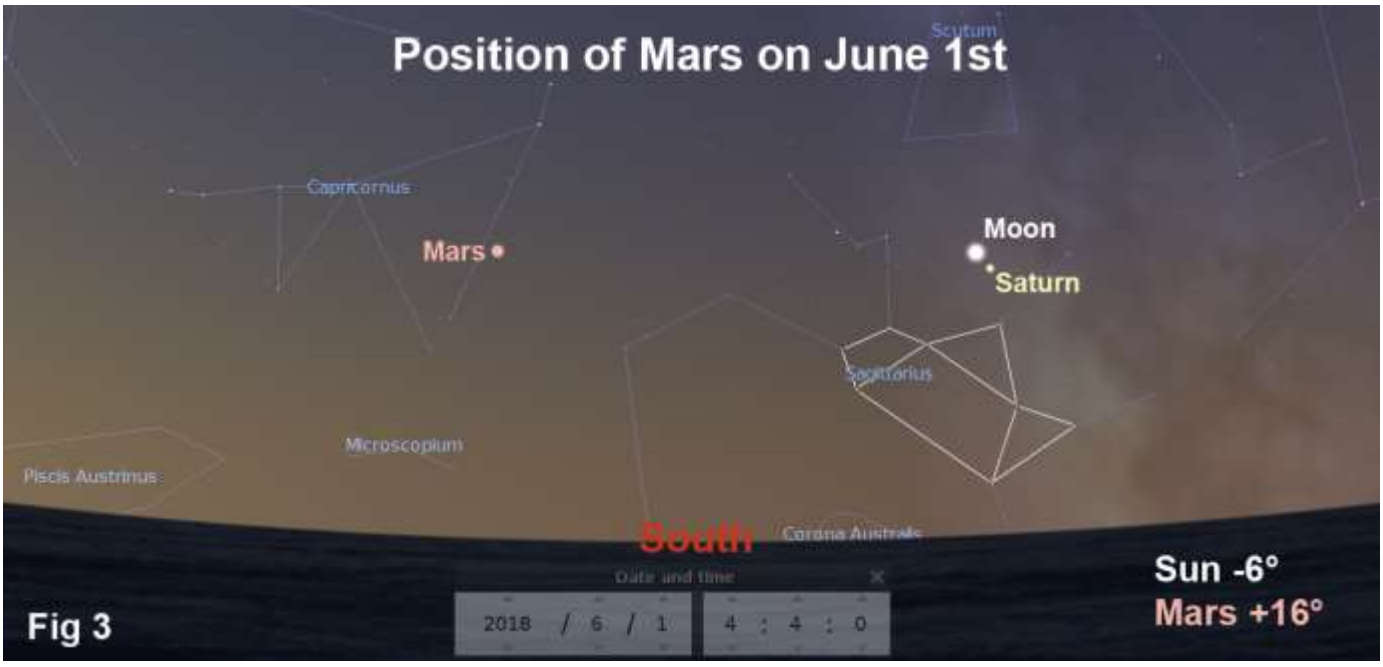
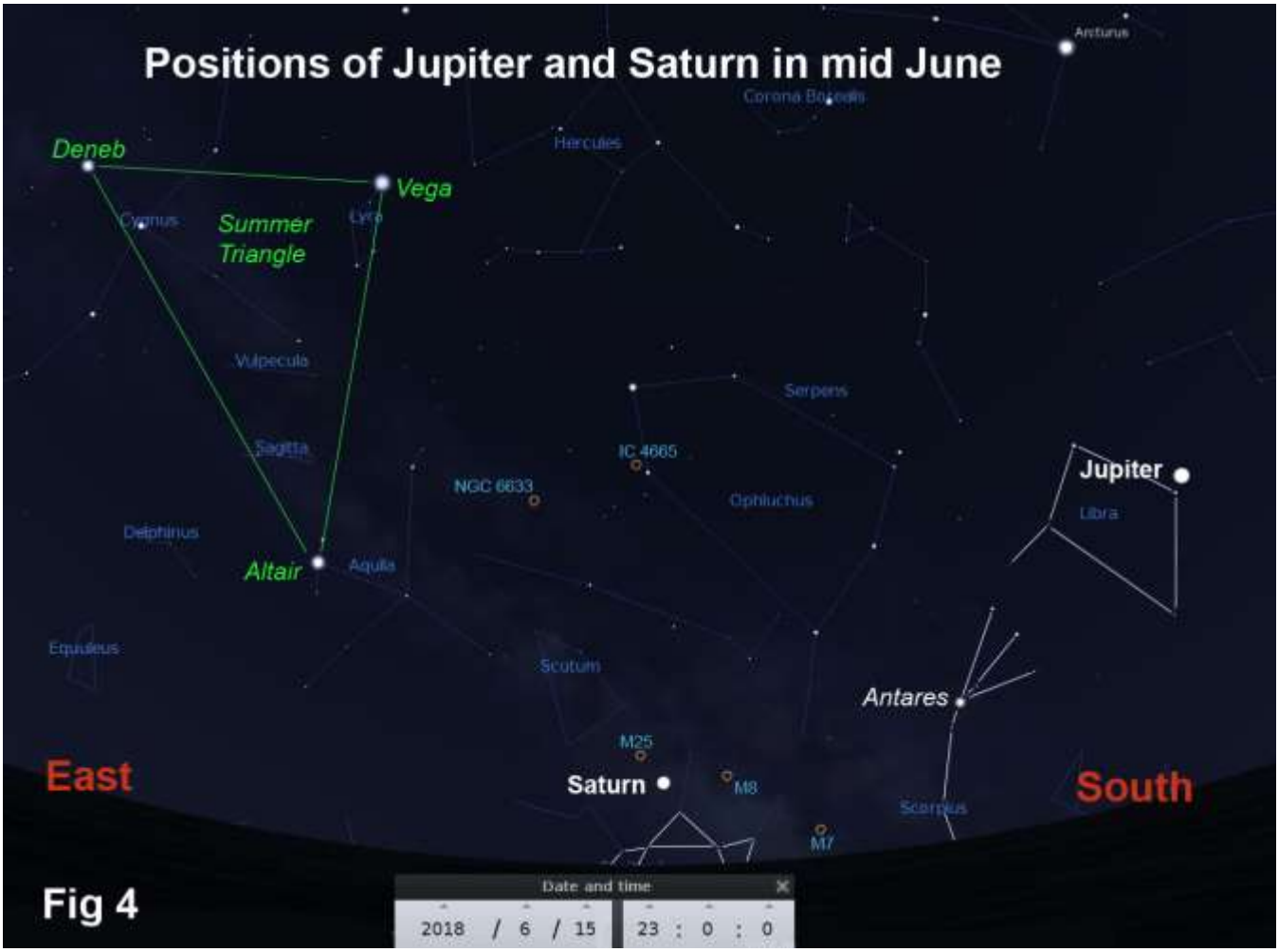


Fig 3

Jupiter was at opposition last month and now rises before sunset. However, it is visible for most of the hours of darkness although its altitude, as seen from the UK leaves much to be desired. By the middle of the month it reaches the meridian (culminates) at 22:00 although by the end this occurs an hour earlier. Jupiter spends all of this month in Libra moving retrograde which it will continue to do until mid-July when it moves direct once more. The brightness of the gas giant slips slightly although by the end of the month it still shines at -2.3 and sports a disk 43" (43 arc seconds) across. Fig 4 shows its position on the 15th at 23:00. However, it is the brightest object by far in that part of the sky and therefore impossible to confuse with anything else. Its availability, and proximity to the Earth, means that its four Galilean moons are an ideal target for small telescopes and tripod mounted binoculars. On June 23rd a waxing gibbous Moon is 3° north of the planet.



Saturn rises a little before 23:00 at the beginning of the month and is in very close company with the Moon on the night of May 31st/June 1st when it will be just 2° north of the ringed planet. Our nearest neighbour in space will again pass just north of Saturn on the evening of June 27th when the separation will be 2.5° although by the time they are preparing to set on the 28th the gap will have shrunk to be just over 1°.
Saturn reaches opposition on June 27th when it will be at its closest to us (a distance of just over 9 AU) and so best positioned for observation. At that time its magnitude will be 0.0 and its angular size 18.4" (18.4 arc seconds). Around the period of opposition the rings always appear slightly brighter than at other times. This is because the position of Saturn relative to the Sun and Earth means that the particles in the rings cast their individual shadows out into space rather than onto each other. This is known as the Seeliger Effect" and is named after the German astronomer Hugo von Seeliger in recognition of the work he did into the composition of Saturn's rings.

Saturn still resides amongst the star fields of the Milky Way, close to the "Teapot" asterism in Sagittarius and moving retrograde. The planet's position is shown in fig 4 where the "Teapot" can just be seen rising. There are numerous clusters and nebulae in this area and I have shown just a few of them on the map.
If you want to look for Titan, Saturn's largest moon, it lies west of the planet on the 7th and 23rd and east of it on the 15th. It has an apparent magnitude of 8.2.

Lunar Occultations
In the table below I've listed events for stars down to magnitude 7.0 that mostly occur before midnight although there are many others that are either of fainter stars or occur at more unsociable hours. DD = **d**isappearance at the **d**ark limb, RD = **r**eappearance at the **d**ark limb and RB = **r**eappearance at the **b**right limb. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. **Times are in BST.**

June	Time	Star	Mag	Phase	Altitude °	% illumination	mm
June 19	00:03	ZC 1562	7.1	DD	7	33	80
June 23	22:08	SAO 158835	7.1	DD	26	83	100
June 25	00:33	ZC 2247	5.4	DD	18	90	50
June 28	23:42	ZC 2779	3.8	RD	13	99	40

Phases of the Moon for June

Last ¼	New	First ¼	Full
6th	13th	20th	28th

ISS

Below are details for passes of the International Space Station (ISS) this month where its brightness is in excess of -1.0. The details of other passes, including those visible between midnight and dawn, can be found at www.heavens-above.com. Please remember that the times and directions shown below are for when the ISS is at it's ***maximum*** elevation, so you should go out and look at least five minutes beforehand. **Times are in BST.**

June	Time	Mag.	Alt°	Az.		June	Time	Mag.	Alt°	Az.
1st	22:58:43	-3.0	36°	SSW		3rd	22:50:16	-2.1	21°	SW
2nd	22:06:28	-3.5	52°	SSW		4th	21:58:04	-2.7	31°	SSW
2nd	23:42:14	-1.6	13°	SW		5th	22:41:39	-1.4	11°	SW

Iridium Flares

The flares that I've listed are magnitude -3.0 or brighter although there are many more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . When one of these events is due, it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter then. **Times are in BST.**

June	Time	Mag	Alt°	Az.°		June	Time	Mag	Alt°	Az.°
3rd	22:57	-4.8	31°	267° (W)		13th	22:33	-3.8	19°	289° (WNW)
4th	22:51	-3.6	31°	269° (W)		15th	22:40	-5.4	14°	296° (WNW)
6th	22:48	-6.0	28°	273° (W)		16th	22:44	-5.1	12°	301° (WNW)
7th	22:42	-3.4	27°	275° (W)		18th	21:20	-6.0	23°	341° (NNW)
9th	22:39	-6.4	25°	279° (W)		21st	22:39	-3.6	37°	37° (NE)
12th	23:14	-4.3	21°	25° (NNE)		26th	22:38	-3.4	27°	277° (W)
13th	22:10	-3.0	12°	345° (NNW)		29th	23:35	-3.1	12°	15° (NNE)

The Night Sky in June (Written for 22.00hrs BST mid month)

In the east, the appearance of Altair means that all of the Summer Triangle is now visible, with the brightest member, Vega in Lyra, at an altitude of almost 50°. Lyra is home to the famous Ring Nebula that Charles Messier catalogued as M57. Its magnitude is 9.7 so should be visible with an aperture of 75 to 80mm although something larger will be needed to see the central star.

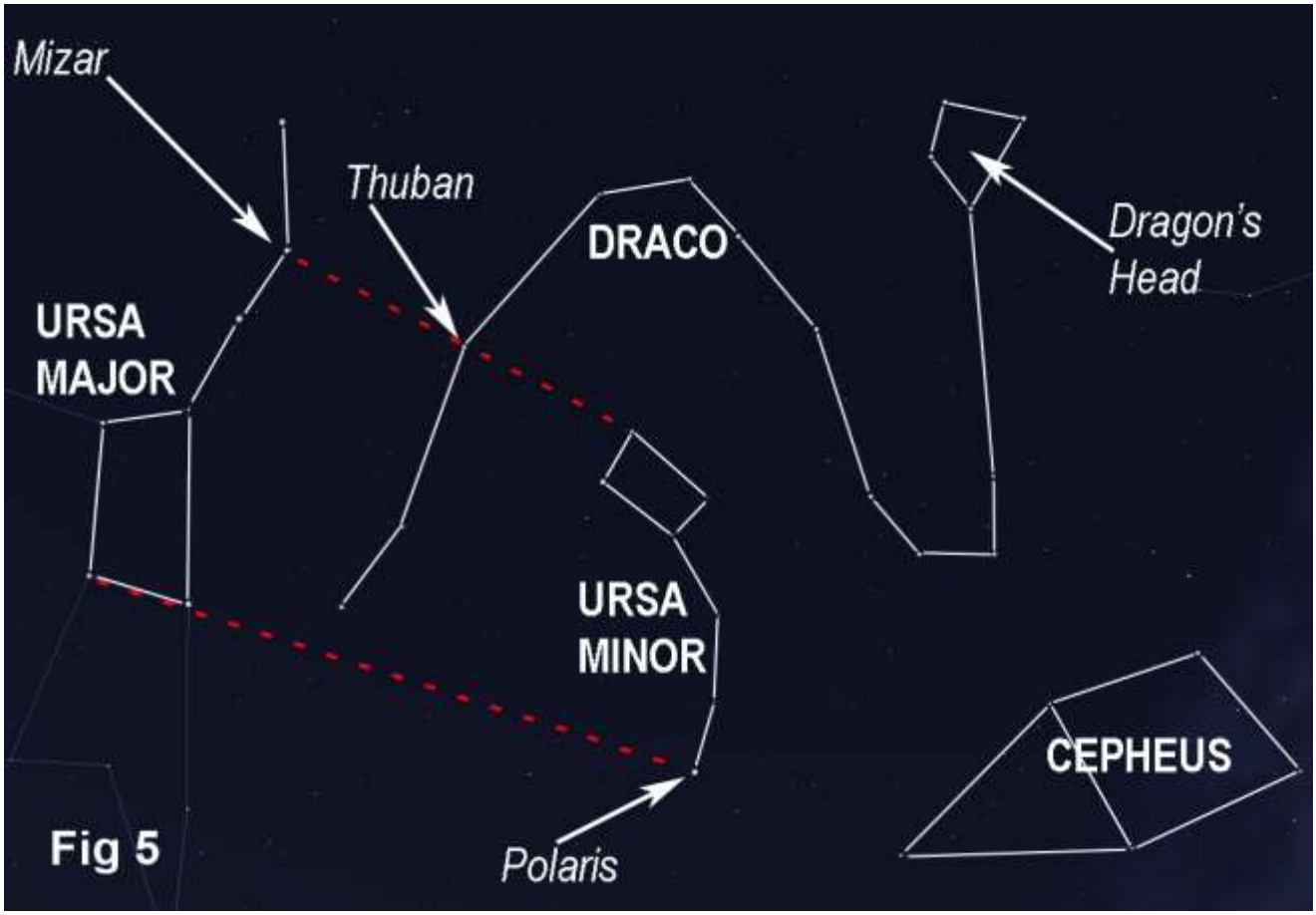
The constellation is also home to the well known "double double" or, more correctly, epsilon (ε) Lyrae. This consists of a double that people with good vision can split with the naked eye, plus each component is itself a double that can be split with an aperture of around 70mm.

The star beta (β) Lyrae gives its name to a type of eclipsing binary whose orbit (in this case) just happens to lie in our line of sight, so we see one component pass in front of the other and witness the apparent change in brightness. There is thought to be some exchange of material between the two stars which has caused the smaller of the two, over time, to become considerably larger.
The line of small constellations that currently appear to stretch from Vega to the horizon are now visible with Delphinus and Sagitta being the most obvious.

Towards the south Boötes lies on the meridian with the northern part of that constellation being the temporary home of the zenith. Below it lies the familiar "Y" shape of Virgo and the quadrilateral of Libra that currently contains Jupiter. A little lower still is Scorpius that is just straddling the horizon although its brightest member, the ruddy hued Antares, is now visible. Some of this area is shown in fig 4 although for slightly later in the evening.

In the west Leo and Cancer are heading for the horizon although despite Gemini being ahead of both of them, the celestial twins, Castor and Pollux, are still 15° above the horizon.

Looking north we find Ursa Major to the west of the celestial pole while its smaller relation is standing on its tail and pointing towards the zenith. Closer to the horizon, the first magnitude star Capella in Auriga, can be seen at an altitude of just 15°. To the east of the pole are Cassiopeia, Cepheus and Draco, the latter of which is well placed for its twists and turns to be identified, with its head reaching towards Hercules. See fig 5. The pointers in Ursa Major, of course, point to Polaris the pole star and a line from Ursa Minor to the Alcor/Mizar double finds the star Thuban half way along that line. Thuban used to be the Pole Star 5,000 years ago before the action of precession robbed it of that title.



Advance Warning
July 12th – Mercury at greatest eastern elongation
July 13th Partial solar eclipse (not visible from the UK)
July 27th – Mars at opposition
July 27th – Total lunar eclipse

Brian Mills FRAS

SPACEPLACE - NASA

This article is provided by NASA Space Place.
With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.
Visit **spaceplace.nasa.gov** to explore space and Earth science!

What Is the Asteroid Belt?

By Linda Hermans-Killiam

There are millions of pieces of rocky material left over from the formation of our solar system. These rocky chunks are called asteroids, and they can be found orbiting our Sun. Most asteroids are found between the orbits of Mars and Jupiter. They orbit the Sun in a doughnut-shaped region of space called the asteroid belt.

Asteroids come in many different sizes—from tiny rocks to giant boulders. Some can even be hundreds of miles across! Asteroids are mostly rocky, but some also have metals inside, such as iron and nickel. Almost all asteroids have irregular shapes. However, very large asteroids can have a rounder shape.

The asteroid belt is about as wide as the distance between Earth and the Sun. It's a big space, so the objects in the asteroid belt aren't very close together. That means there is plenty of room for spacecraft to safely pass through the belt. In fact, NASA has already sent several spacecraft through the asteroid belt!

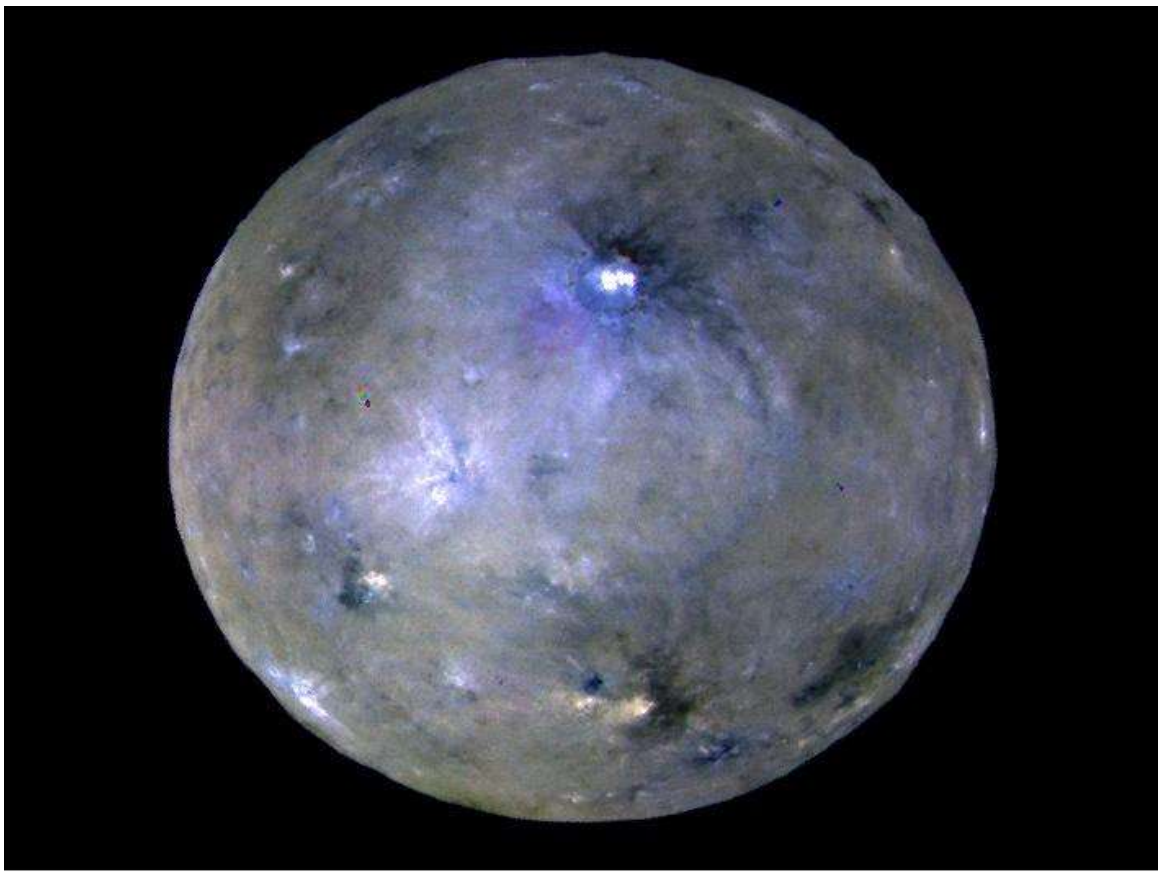
The total mass of objects in the asteroid belt is only about 4 per cent the mass of our Moon. Half of this mass is from the four largest objects in the belt. These objects are named Ceres, Vesta, Pallas and Hygiea.

The dwarf planet Ceres is the largest object in the asteroid belt. However, Ceres is still pretty small. It is only about 587 miles across—only a quarter the diameter of Earth's moon. In 2015, NASA's Dawn mission mapped the surface of Ceres. From Dawn, we learned that the outermost layer of Ceres—called the crust—is made up of a mixture of rock and ice.

The Dawn spacecraft also visited the asteroid Vesta. Vesta is the second largest object in the asteroid belt. It is 329 miles across, and it is the brightest asteroid in the sky. Vesta is covered with light and dark patches, and lava once flowed on its surface.

The asteroid belt is filled with objects from the dawn of our solar system. Asteroids represent the building blocks of planets and moons, and studying them helps us learn about the early solar system.

For more information about asteroids, visit: https://spaceplace.nasa.gov/asteroid



Caption: This image captured by the Dawn spacecraft is an enhanced colour view of Ceres, the largest object in the asteroid belt. Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

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Any material for inclusion in the July 2018 Newsletter should be with the Editor by June 28th 2018