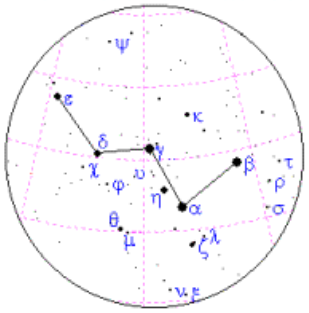


Wadhurst Astronomical Society Newsletter April 2018

MEETINGS

COMMITTEE MEETING

Members of the Committee are respectfully reminded that there is a meeting of the Committee at Jim's House beginning at 1930 on Tuesday 10th of April 2018.

MARCH MEETING

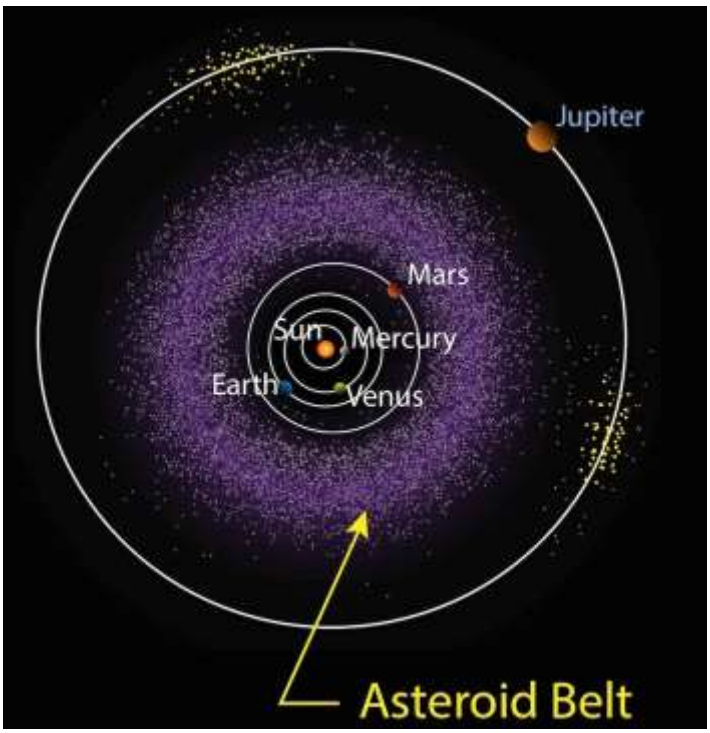
The March meeting was led by Phil Berry who, after outlining the evening's programme introduced this month's speaker, William Joyce.

William has given us a number of informative and enjoyable talks before and we were delighted to welcome him back. He lectures in astronomy, astro-physics and planetary science and, as well as a communicator, is also an avid observer. He has a BSc in physics and astronomy; a BSc in Earth and Planetary Science and is a Fellow of the Royal Astronomical Society.

Asteroids and Comets
William Joyce

William's talk began with a look at asteroids. A diagram of the Solar System's inner planets showed the position of different asteroids with the main mass lying in orbits between Mars and Jupiter but with a large number within the orbit of Mars and referred to as Near-Earth Objects (NEOs), some of which could even be a threat in the future.

Another diagram that included Jupiter showed the effect of Jupiter's mass on the main asteroids belt, creating two groups of asteroids, positioned 60° in front of and behind Jupiter in the planet's orbit orbit. These were referred to as the Trojan asteroids.



Asteroid belt showing the Trojan asteroids in Jupiter's orbit - NASA

It was pointed out that although the asteroids might appear to be close together, they are in fact millions of miles apart.

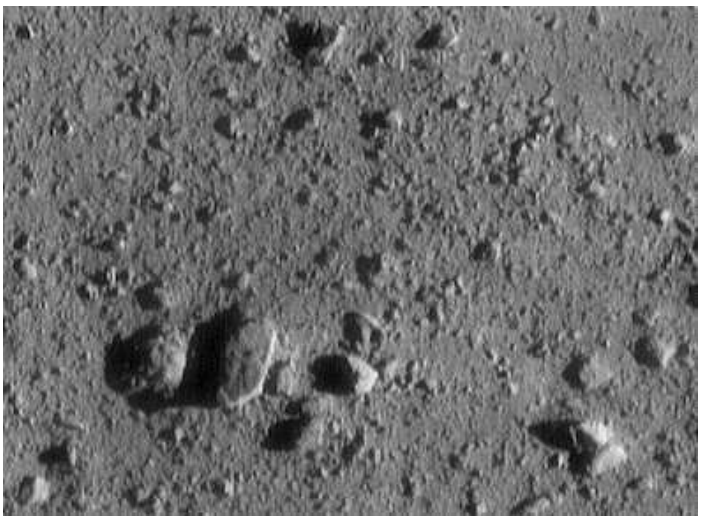
William talked about the two moons around Mars, Phobos and Deimos and said that it is most likely that they are in fact captured asteroids.

Another asteroid, Ida, was the first asteroid found to have a moon whose name is Dactyl.

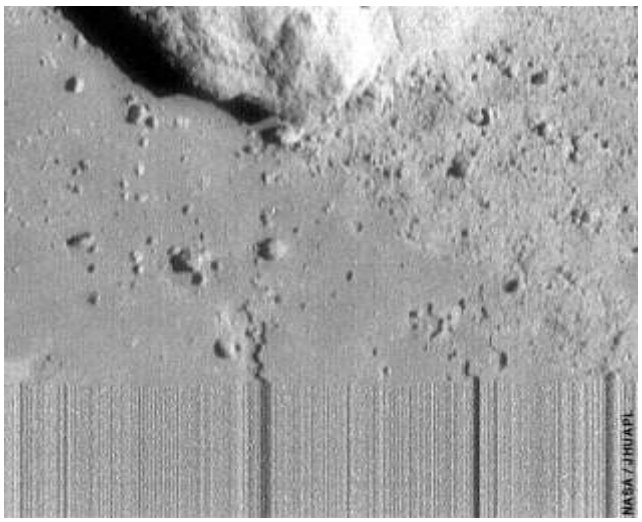
Ida has an average diameter of about 20 miles with a small moon about a mile across, named Dactyl - NASA

Many images of asteroids were made by the Hubble Space Telescope and it was also found that some of the them had a density less than that of water. Then in the 1990s asteroids began to be visited by spacecraft.

We were shown images taken by spacecraft NEAR-Shoemaker of the surface of Eros showing its similarity to the close-up surface of the Moon.



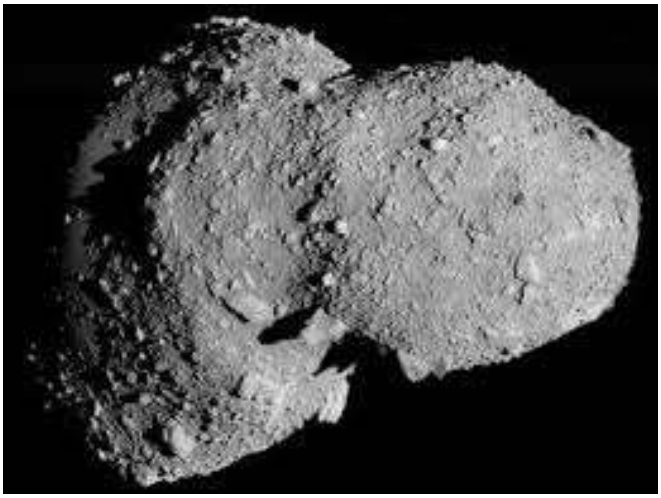
The surface of Eros about 30 metres across – NEAR Shoemaker - NASA



Last image taken as NEAR-Shoemaker touched down on Eros - NASA

Although NEAR - Shoemaker was not intended to survive a landing, it was put down on the surface of Eros and the picture on the right above shows the surface just before touchdown as the camera failed. The spacecraft did in fact survive for some time.

William told us about one asteroid visited by the Japanese. This was Itokawa, only 500 metres long. He said that it probably consisted of two or three asteroids stuck together by weak gravity. The gaps in between would have filled with dust.

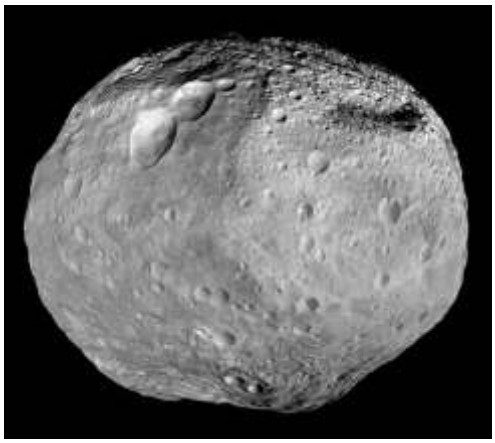


Asteroid Itokawa, visited by a Japanese spacecraft launched in 2005

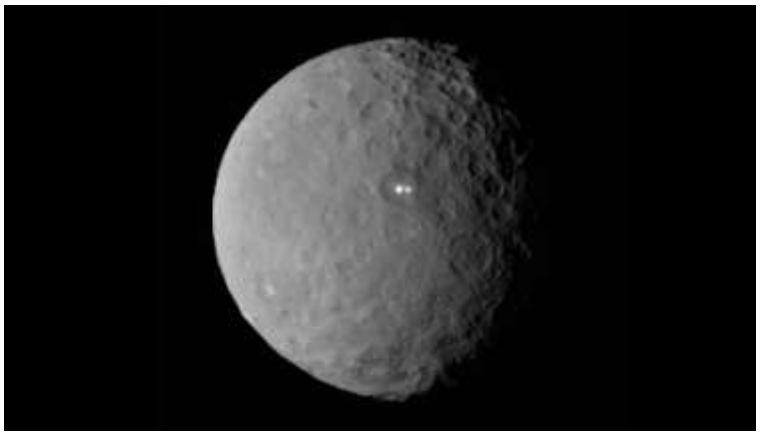
The Japanese managed to collect a small sample of the surface and return it to Earth in 2010.

Many of the larger asteroids contain metals and William talked about the second-largest asteroid, Vesta, which is thought to have a nickel-iron core. It was visited in 2011.

Vesta has an enormous impact crater which, we were told is in fact a sliced off region of the asteroid and in the centre and in this is a peak called Rheasilvia Mons and we were informed that this is the biggest known mountain in the Solar System at a height of 23 km.



Vesta. The lower part of the image shows where a the giant impact crater is - NASA

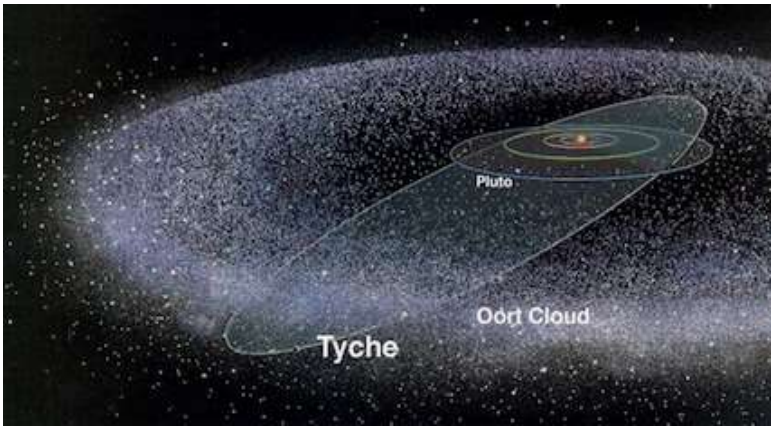


Ceres, showing white material at the centre of the impact crater - NASA

Ceres is the largest asteroid in the solar system and was originally thought to be the eighth planet when first discovered in 1801 but has later been classified as a dwarf planet. The large crater shown in the image above was seen to have white markings, which are now known to be ice deposits containing salts.

William now looked at comets for the second part of his talk.

It is thought that long period comets originate in what is known as the Oort Cloud, which lies beyond the Kuiper Belt, which itself begins close to the orbit of Pluto. Short period comets are believed to originate in the Kuiper Belt.



Beyond the orbits of the outer planets and the Kuiper Belt lies the mysterious Oort Cloud

We were told that very little is known about the Oort Cloud. It is believed to be populated with black objects probably only a few metres across.

Objects in the Oort Cloud can be affected by events outside the solar system such as super-novae or dark nebula, causing their orbits to be disturbed and triggering their journey out of the Oort cloud either further into space or towards the Sun.

William briefly looked back at the way comets were perceived in ancient times, often regarded as portending disasters. They seemed to appear randomly in the clear black night skies sometimes at the time of unexpected events so the superstitious ancient people attempted to link them.

One comet was recognised by Edmund Halley as returning every 76 years or so and led him to predict when the comet would return in the future. This became known as Halley's comet and we were shown an image. As it returned in 1910, astronomers then had spectrometers and were able to discover what the comet was composed of, although amongst other materials they found cyanide and formaldehyde. When it was found that the Earth would pass through Halley's Comet's tail, newspapers were full of warnings that everyone would be poisoned - which didn't happen.

Comet Shoemaker-Levy 9 once orbited the Sun but its orbit was disturbed by Jupiter's enormous mass and in 1994 the comet broke up and landed as a series of separate pieces, some about twice the size of the Earth, leaving a line of impacts across Jupiter's gaseous surface, each with the energy of about a million times that of the Hiroshima bomb.

In 1997 Hale-Bopp could be seen in the night sky.

Comet Hale-Bopp in 1997

It was explained that Hale-Bopp had two tails. The wide yellowish tail was dust trailing out behind the comet but the blue tail was ionised gas flowing directly away from the Sun due to solar wind. At the head was a diffused atmosphere with the core deep inside.

Most comets can only be seen through binoculars but also SOHO, **SO**lar and **H**eliospheric **O**bservatory, monitors the activity of the Sun and by blocking out the light from the Sun itself has discovered comets very close to it.

William said that comets can be short term with elliptical orbits taking less than 200 years before they return, then long term comets taking perhaps thousands of years to complete an orbit and finally comets whose orbits are hyperbolas, which come just once and never return.

Some comets leave a dust tail that the Earth passes through causing meteor showers. Halley's comet has a tail that has divided and there are two distinct peaks in the meteor shower, known as the Orionids in October.

In 2005, NASA's Deep Impact mission successfully collided with comet Temple 1. It was found to contain more dust and less ice than had been thought.

In 2014 ESA's Rosetta mission reached a tiny comet known for short as 67/P. It had a lander called Philae that was meant to land on three legs and two harpoons were intended to fire anchors into the surface to hold it there. Unfortunately, the surface was hard and because the harpoons failed to deploy, the craft bounced up again, wedging in a cliff and out of sunlight. Measurements were still made and a lot of information is even now being analysed from the data, and will continue to be so for some time to come.

Snippets from the World of Science
John Wayte

If you live in a valley, do you live longer than if you live on top of a mountain?

Well according to Einstein, you do because gravity at the top of a mountain; is weaker than at the bottom. Einstein's General Theory of Relativity claimed that time moves more slowly when gravity is stronger.

Not by a lot I admit but never the less it is measurable. And for that you need a reasonably accurate timepiece. And you know where this is leading us – an Atomic Clock.

These super accurate atomic clocks require extreme cold and stability, and the best ones will measure time with an error of 1 in a billion billion! In other words, an error of less than half a second since the Big Bang. And it's only recently that a special trailer has been developed to provide the right conditions for the Strontium Clock to be transportable.

And just for complexity's sake, a bit of useless information; these new breed of strontium clocks are so accurate that even lifting them off the floor and putting them on a wall will make a difference in the time. They will speed up by 1-part in10^{16}.

So, if you live in a valley in Italy you will live longer that if you live in the Alps in France.

In other words, you would have to live for 119,047,619 years to increase your life by one second. Hope you like Italian food…

My visit to see the aurora.

Aurora Borealis – the Northern Lights – are on the north side of the equator. In the southern hemisphere the 'Southern Lights' are called the Aurora Australis.

So, you all know exactly what I mean and don't need me to tell you that they are an incredible light show caused by collisions of electrically charged particles released from the Sun, that enter the Earth's atmosphere near the poles and collide with gases such as oxygen and nitrogen.

Apparently the Northern and Southern lights are usually mirror images of each other.

As you all know, the Sun releases charged particles from its sunspots, which head outwards in a Solar Wind. The Earth's magnetic fields protect us from these harmful rays but are weaker at the poles; these particles then collide with Earth's gases to form these spectacular lights.

The colours are formed by different gases in the atmosphere.

Green – the most common colour comes from oxygen at 60 miles above the Earth. Rarer red – again oxygen but at about 200 miles. Blue or purple – Nitrogen.

The height of the aurora is formed at an altitude of between 50 and 200 miles.

There is an App for your phone which will give predictions of the levels of the aurora; www.aurora-service.eu

How do I photograph the Northern Lights?

- Flash off
- ISO 400, 800 or 1600 (the darker sky, the higher the ISO needed)
- White balance; daylight setting
- Shutter (Tv); 10 to 30 seconds
- Focus: manual focus to infinity
- Self-timer: set to 2 seconds (reduces camera shake)
- LCD: low brightness

Additional settings for Digital SLR cameras:

- Shooting mode: Manual (M)
- Aperture (AV): lowest possible setting
- Lens: wide angle (below 35mm)
- UV or Polarizing filter: remove

Additional tips for getting great shots of the Northern Lights:

- Have your gear ready to go (batteries charged, space available on memory cards, warm weather gear)
- Use a tripod or the ships railing to stabilize yourself when shooting
- Be respectful of other photographers
- Be patient – conditions can change. The lights often change their intensity and appearance throughout the night

Most important. Experience the beauty of the aurora with your own eyes and heart first!

John's talk was followed by the Sky Notes given by Brian Mills FRAS and follow later in the newswletter

APRIL MEETING

18 April 2018 – Sadly Barry Soden, who was to have given the April talk has been taken ill and we wish him well. We hope to invite him back to give his talk at a later date when he has recovered. We are fortunate that Melanie Davies, who has spoken to on many occasions, has agreed to give the April talk. Her subject is "Astrology meets Astronomy".

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

16 May 2018 – Colin Stuart tells us " How to Weigh the Universe"

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

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

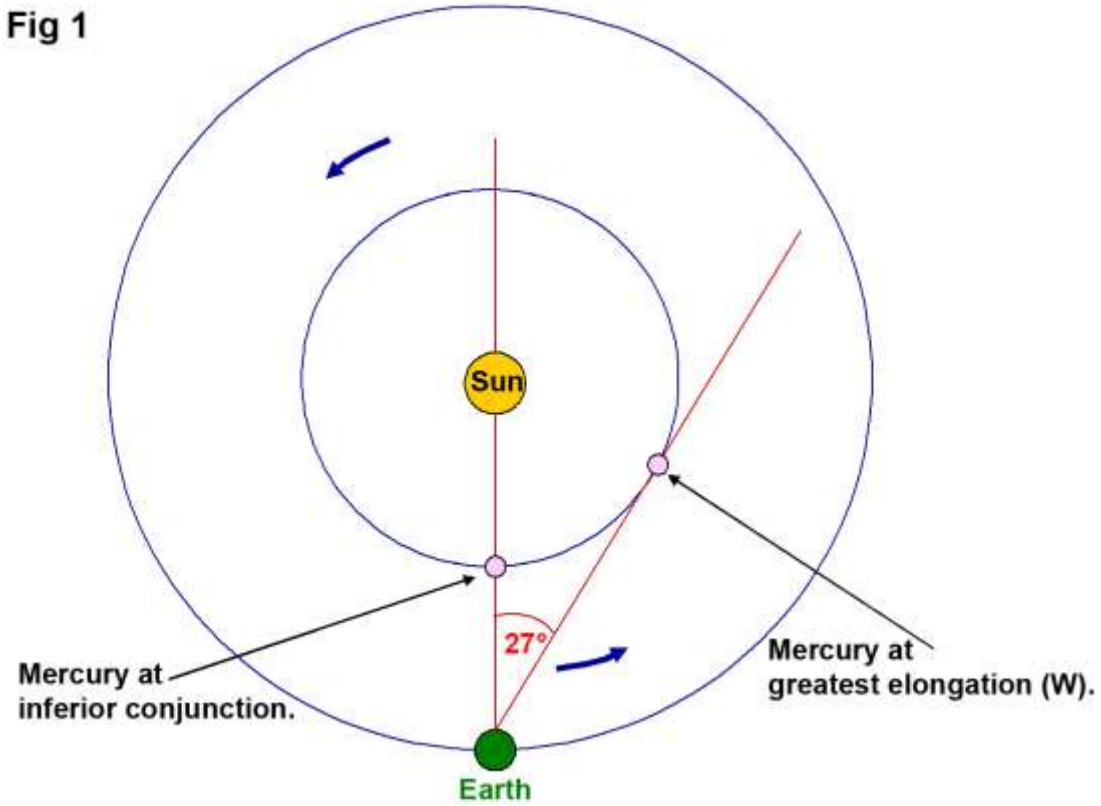
There is no meeting in August

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

SKY NOTES FOR APRIL 2018

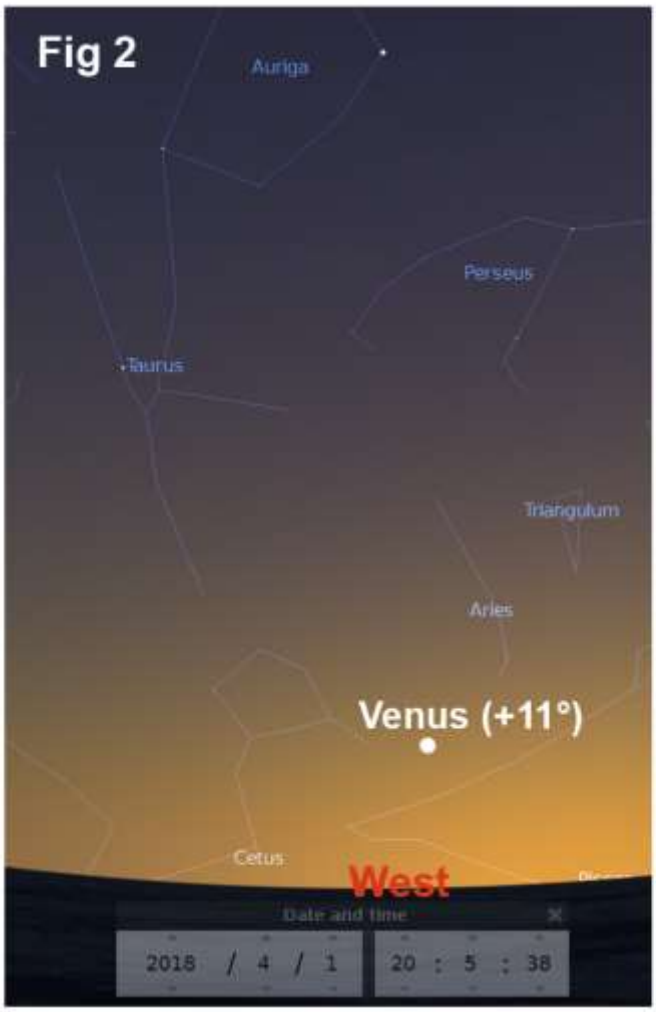
Planets

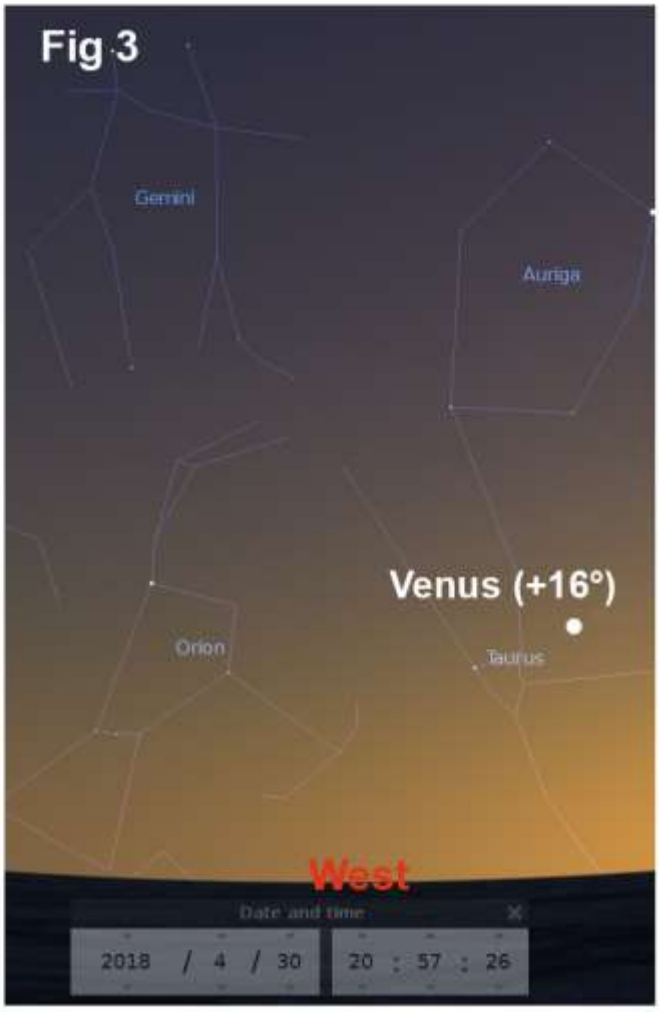
Mercury reaches inferior conjunction on the 1st and then moves west of the Sun to become a morning object. This will be a very poor apparition as seen from the UK partly because although the planet is a little north of the celestial equator, the Sun is also there now following the spring equinox in late March. To add to the difficulties the ecliptic is close to the horizon in the early hours of the morning at this time of year. The net result is that on the morning of April 29th, when greatest elongation occurs, Mercury rises just thirty minutes before the Sun even though its elongation is 27°. This will mean that it is effectively unobservable from the latitudes of the UK. Fig 1 shows the relative positions of the bodies involved at inferior conjunction and western elongation.



Of course when Mercury, or Venus for that matter, are at inferior conjunction the conditions are right for a transit to occur. This is when we see the dark body of the planet pass across the face of the Sun. Transits of Mercury are much more common than transits of Venus because Mercury is closer to the Sun and orbits more quickly providing around 14 events per century. The next transit of Mercury will take place on November 11th 2019 when approximately three quarters of the event will be visible from the UK. We will see ingress at 12:35 but will not see the egress phase because the Sun will set at 16:10. The planet is well positioned and passes close to the centre of the solar disk.

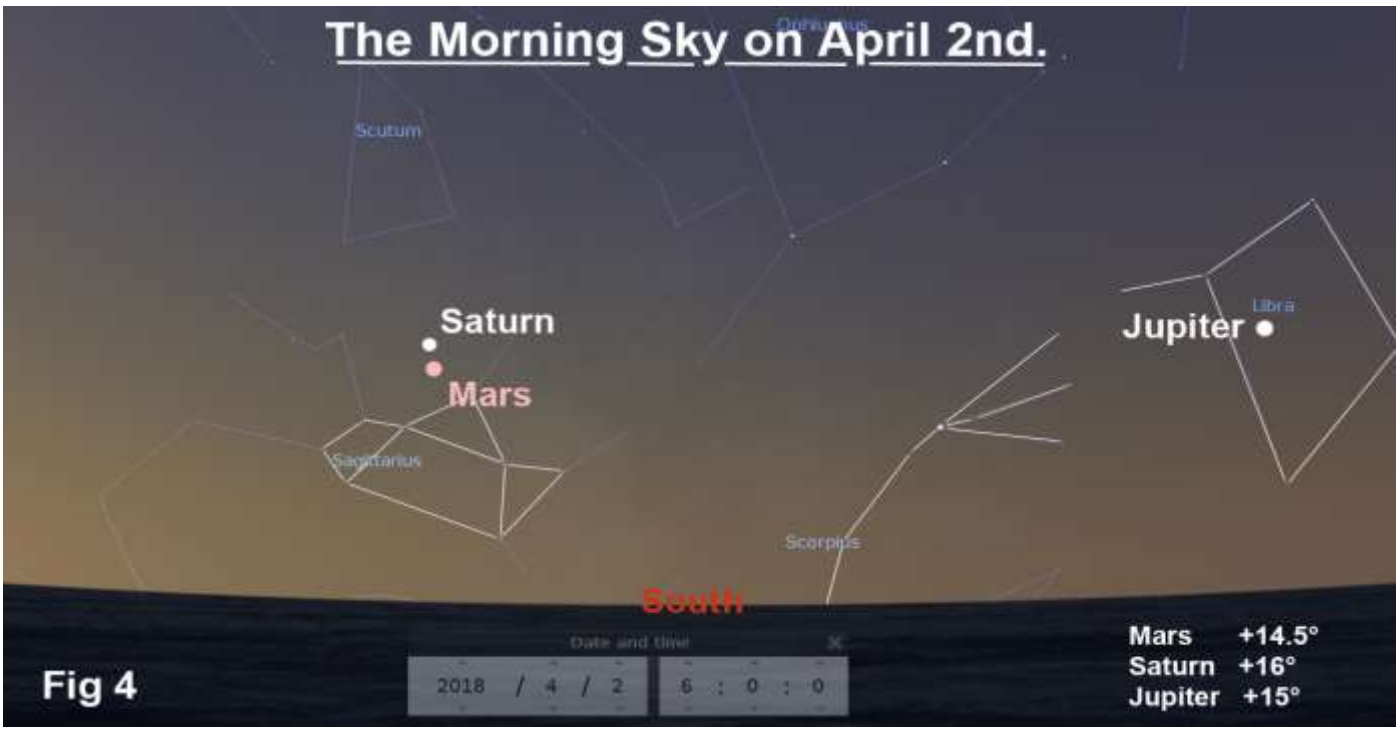
Venus is becoming a more prominent evening object now though the improvement in its visibility is rather slow. On the first of the month (with the Sun 6° below the horizon) it is 11° high whilst on the last day it is 16° in altitude and has also moved in azimuth. This is because the ecliptic changes position not only by the time of the year but by the time of day as well. Fig's 2 and 3 show how the planets position varies from the first day to last days of the month.





The magnitude of Venus remains constant at a brilliant -3.9 during April although it will increase gradually from June onwards as the planet draws closer to Earth despite its phase declining. When at its furthest from Earth, at superior conjunction, Venus has an apparent diameter of just 10" (10 arc seconds) but at its closest to Earth, at inferior conjunction, it grows to a massive 66" (66 arc seconds) which is a little over 1 arc minute.

Mars is a morning object rising at 03:00 at the start of April and 02:00 by the end. In both instances the Sun will have risen before the red planet has reached the meridian.



Mars continues to grow in brightness and apparent size in readiness for opposition in late July; an event that only occurs every two years or 780 days to be precise. During April its magnitude moves into negative figures to become -0.3 whilst its size rises to 8.4" (8.4 arc seconds) although by the time of opposition it will appear to be a very reasonable 24.3" across. Mars spends the month in Sagittarius moving swiftly eastwards and passing just south of a slightly fainter Saturn on April 2nd/3rd as shown in fig 4. Then on the 2nd it is within ½° of the globular cluster M22 at magnitude +5.5.

Jupiter rises at 23:00 at the start of April so it is technically an evening object but is best seen in the early morning skies. However, by the end of the month it rises at 21:00 when the Sun is just 6° below the western horizon which is as what we would expect as Jupiter approaches opposition on May 9th. At the time of opposition, when the gas giant is "opposite" the Sun in the sky, it will rise in the east as the Sun sets in the west and vice versa in the morning. Fig 5 shows the positions of the three bodies involved in both opposition and conjunction.

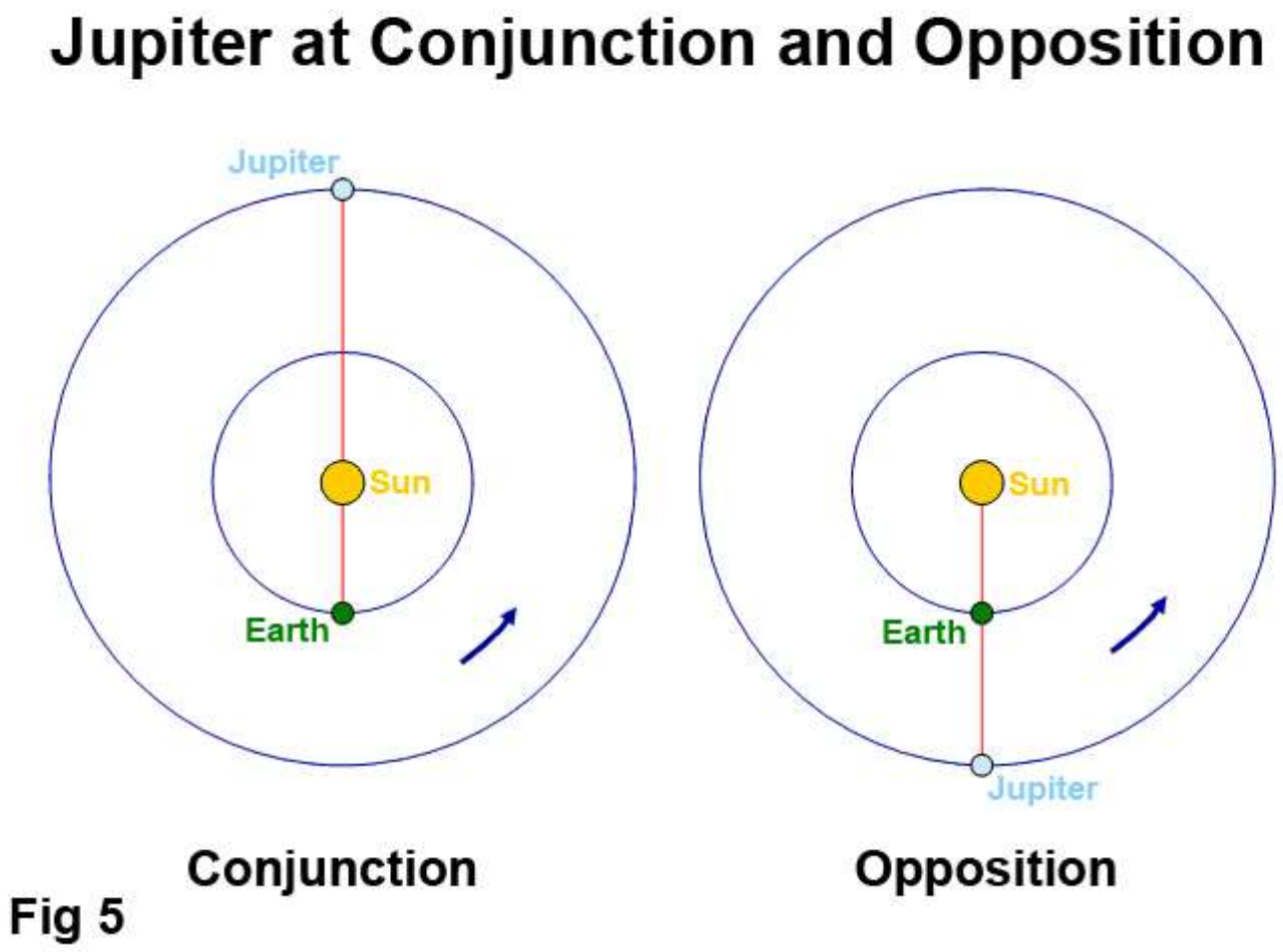


Fig 5

Jupiter continues to brighten slightly as it approaches maximum magnitude at the time of opposition. Its apparent size also increases as the planet draws closer to the Earth. It continues to move retrograde, east to west, through Libra (see fig 4) although it won't reach the constellations borders before returning to "direct" motion. An almost full Moon is close by on the evening of April 30th.

Saturn, as shown in fig 4, is also a morning object rising at around 03:00 at the beginning of the month. It is still moving slowly amongst the stars of Sagittarius, just north of the "Teapot" asterism. On April 18th it reaches its first stationary point after which it begins to travel retrograde. Like Jupiter, it is also moving towards opposition although in the case of Saturn this won't occur until late June. It reaches magnitude +0.4 and 17.4" (17.4 arc seconds) in apparent size if you ignore the rings or 39.1" if you include them. The tilt of the planets north pole towards the Earth (currently just over 25°) provides excellent views of the ring system. As mentioned above, Mars passes close by on April 2nd/3rd. If you want to observe Saturn's largest moon, Titan, it is best to look to the east of the planet on the 12th and 28th and to the west on the 4th and 20th as these are the dates when it will be at greatest elongation. Titan varies in brightness between magnitudes +8.2 and +9.0.

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.**

April	Time	Star	Mag	Phase	Altitude °	% illumination	mm
20th	21:03	ZC 940	5.8	DD	36	27	40
26th	22:28	ZC 1728	6.7	DD	42	89	80

Phases of the Moon for April

Last ¼	New	First ¼	Full
8th	16th	22nd	30th

ISS

Below are details for passes of the International Space Station (ISS) this month where its brightness is in excess of -2.0. 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.**

April	Time	Mag.	Alt°	Az.		April	Time	Mag.	Alt°	Az.
1st	20:50:16	-3.8	78°	N		5th	20:33:56	-3.8	78°	SSW
2nd	21:34:29	-4.0	84°	S		6th	21:17:53	-2.8	36°	SSW
3rd	20:42:09	-3.8	83°	N		7th	20:25:36	-3.3	52°	SSW
4th	21:26:15	-3.6	59°	SSW		9th	20:17:09	-2.4	31°	SSW

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.**

Apr.	Time	Mag	Alt°	Az.°		Apr.	Time	Mag	Alt°	Az.°
2nd	21:40	-6.5	15°	357° (N)		19th	23:31	-6.3	15°	263° (W)
6th	21:37	-3.1	15°	356° (N)		20th	23:24	-6.2	15°	265° (W)
9th	20:51	-7.6	30°	355° (N)		21st	23:28	-6.1	13°	268° (W)
10th	21:04	-6.6	25°	354° (N)		22nd	23:22	-3.4	14°	270° (W)
12th	20:49	-4.5	30°	353° (N)		23rd	23:20	-6.0	13°	273° (W)
15th	23:41	-6.0	16°	253° (WSW)		23rd	23:25	-5.9	12°	273° (W)
16th	20:26	-4.3	36°	351° (N)		27th	20:37	-5.0	15°	273° (W)
17th	23:33	-3.9	16°	258° (WSW)		29th	21:50	-5.6	13°	351° (N)

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

Looking north Ursa Major lies almost overhead with the zenith proper just a handful of degrees from the bowl of the plough. If the great bear is so positioned then it follows that Cepheus, which is on the opposite side of the pole, should be close to the horizon and on the meridian. Cassiopeia and Perseus lie to the west of Cepheus whilst to its east we find the head of Draco, the dragon. Deneb, one of the stars that form the summer triangle, is now gaining height to join Vega, another triangle member, which has reappeared in the north east although from parts of the UK it very literally grazes the horizon.

In the east Hercules has fully risen bringing with it two excellent globular clusters. M13 is probably the best known of these objects and with good reason. It is the most spectacular globular visible to those of us in the northern hemisphere and at magnitude +5.8 it is technically possible to see it with the naked eye from a really dark site. The other is M92, which is not as striking but still well worth seeking out at magnitude 6.3. Just east of Hercules lies Corona Borealis, the Northern Crown, and further east still is Boötes, the celestial herdsman, which contains Arcturus, the fourth brightest star in the night sky.

Turning to the south we find Leo straddling the meridian with its brightest star Regulus at an altitude of 50°. Just west of Leo is the faint group of stars that make up Cancer, which contains the two open clusters of M44 and M67. Below Cancer lies the head of Hydra, the water snake, who's entire body has now cleared the horizon for us to follow its many twists and turns. Hydra is not only the largest but also the longest of the modern 88 constellations. It was also one of 2nd century astronomer Ptolemy's original 48. Riding on the back of the water snake are two other small but reasonably obvious groups; Crater (the cup) and Corvus (the crow). Crater is mostly formed by a quadrilateral and the more prominent of the two. Corvus is slightly fainter and usually drawn by joining an irregular four and five sided figure together. It more obviously seems to present itself, using the three brightest stars, as a triangle lying on its side and pointing west.

Moving to the west, Orion and Taurus are just about to set with the remainder of the winter retinue close behind. However, the celestial twins, Castor and Pollux, are still 50° in altitude with Capella at 40° and Procyon at 30°. The height of Gemini means that the open clusters that have congregated at the feet of Castor are still moderately well placed. The brightest of these are M35 and NGC 2129. Just across the border in Taurus is the very first faint fuzzy object that Charles Messier put on his list – M1. This is the remnant of a supernova that exploded back in 1054 and was recorded by the Chinese astronomers of the day. At magnitude +8.4 you might just be able to locate it with binoculars but a moderate sized telescope is really needed to see any detail.

Meteors

The Lyrids are active from April 18th to 25th with maximum occurring on night of April 21st/22nd as the Earth passes through the debris trail of Comet Thatcher. At that time the zenithal hourly rate (ZHR) would be around 15 given perfect conditions and the radiant at the zenith. However, by midnight the radiant will only be just over 30° in altitude as shown in fig 6. A first quarter Moon will set in the north-west at 02:00 when the radiant will be 50° in altitude in the east.

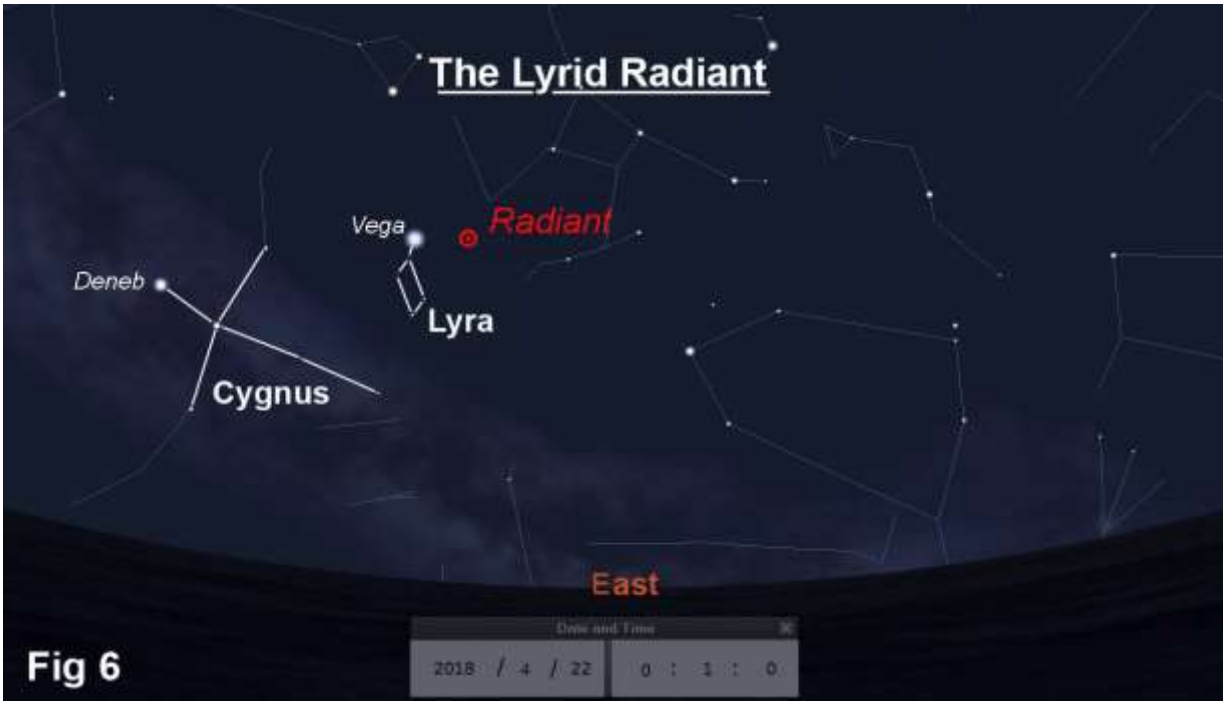


Fig 6

Brian Mills FRAS

2018 SUBSCRIPTIONS

Subscriptions to the Wadhurst Astronomical Society became due from the 1st of January 2018, but at the AGM it was reluctantly decided that an increase had become necessary. On March 1st they rise by £2 to £20 per adult and £27 for two family members at the same address. Members under 17 years of age and students remain free.

Subscriptions can be paid either by cheque made payable to Wadhurst Astronomical Society or as cash at the meetings or by post to:
John Wayte
Members Secretary
Wadhurst Astronomical Society
27 Pellings Farm Close
Crowborough
East Sussex
TN6 2BF

The Subscriptions can also be paid via electronic banking to:
Wadhurst Astronomical Society
Account Number **35104139**
Sort Code **60-22-15**
Putting your name as the **Reference** so we know who is paying.

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Measuring the Movement of Water on Earth
By Teagan Wall

As far as we know, water is essential for every form of life. It's a simple molecule, and we know a lot about it. Water has two hydrogen atoms and one oxygen atom. It boils at 212° Fahrenheit (100° Celsius) and freezes at 32° Fahrenheit (0° Celsius). The Earth's surface is more than 70 per cent covered in water.

On our planet, we find water at every stage: liquid, solid (ice), and gas (steam and vapour). Our bodies are mostly water. We use it to drink, bathe, clean, grow crops, make energy, and more. With everything it does, measuring where the water on Earth is, and how it moves, is no easy task.

The world's oceans, lakes, rivers and streams are water. However, there's also water frozen in the ice caps, glaciers, and icebergs. There's water held in the tiny spaces between rocks and soils deep underground. With so much water all over the planet - including some of it hidden where we can't see - NASA scientists have to get creative to study it all. One way that NASA will measure where all that water is and how it moves, is by launching a set of spacecraft this spring called GRACE-FO.

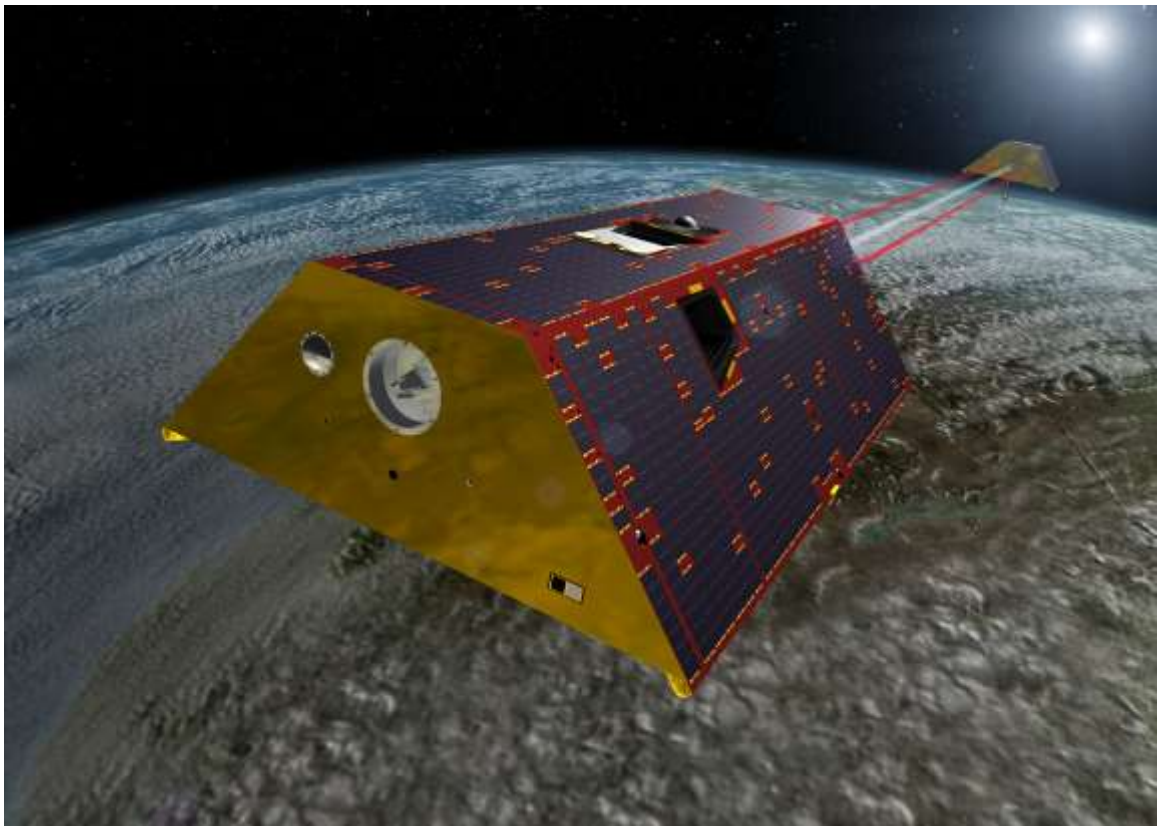
GRACE-FO stands for the "Gravity Recovery and Climate Experiment Follow-on." "Follow-on" means it's the second satellite mission like this - a follow-up to the original GRACE mission. GRACE-FO will use two satellites. One satellite will be about 137 miles (220 km) behind the other as they orbit the Earth. As the satellites move, the gravity of the Earth will pull on them.

Gravity isn't the same everywhere on Earth. Areas with more mass - like big mountains - have a stronger gravitational pull than areas with less mass. When the GRACE-FO satellites fly towards an area with stronger gravitational pull, the first satellite will be pulled a little faster. When the second GRACE-FO satellite reaches the stronger gravity area, it will be pulled faster, and catch up.

Scientists combine this distance between the two satellites with lots of other information to create a map of Earth's gravity field each month. The changes in that map will tell them how land and water move on our planet. For example, a melting glacier will have less water, and so less mass, as it melts. Less mass means less gravitational pull, so the GRACE-FO satellites will have less distance between them. That data can be used to help scientists figure out if the glacier is melting.

GRACE-FO will also be able to look at how Earth's overall weather changes from year to year. For example, the satellite can monitor certain regions to help us figure out how severe a drought is. These satellites will help us keep track of one of the most important things to all life on this planet: water.

You can learn more about our planet's most important molecule here: https://spaceplace.nasa.gov/water



An artist's rendering of the twin GRACE-FO spacecraft in orbit around Earth. Credit: NASA

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