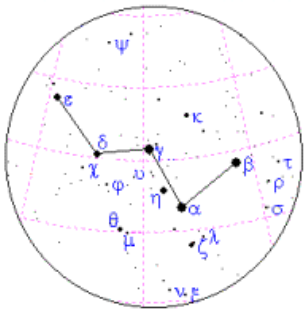


Wadhurst Astronomical Society Newsletter February 2017

2017 SUBSCRIPTIONS

Subscriptions to the Wadhurst Astronomical Society became due from the 1st of January 2017. But at the AGM it was reluctantly decided that an increase had become necessary as explained in the AGM report later in the newsletter. The subscriptions remain at £16 per adult member and £23 for two members at the same address until March 1st when they rise by £2 to £18 per adult and £25 for two 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.

THE CHAIRMAN'S LETTER

Firstly, may I say thank you to all the members and visitors who have supported the Society over the last year, and particularly those who braved the cold to attend the AGM in mid January? These meetings are never the most popular, although it is important that we give you the opportunity to "have your say". We always try to keep the formal business to a minimum and move on to the less formal items as quickly as possible, whilst still allowing you time to scrutinise the Officer's reports and question them if required. This year the AGM is followed by two short talks instead of one main speaker as this format seemed well received when we tried it in the middle of last year.

At the moment the Committee is slightly under strength and would benefit from the addition of one more member. We meet four times per year, in the evenings to discuss, in general, how the Society will be run and how we can provide an enjoyable programme of speakers and events. We are also looking for someone to take over our small Library that needs to be present at our monthly meetings although this doesn't have to be a committee member. It just needs to be someone who can attend most meetings and store the books in between. The Library is small and fits into one moderately sized plastic crate. Please e-mail me using the address towards the end of this Newsletter if you are interested or would like more information. Eric very kindly stepped in at short notice to look after the Library on a short term basis for us and make sure it was available to members.

We continue to use the classrooms IL5 and IL6, which I think are considerably better than the Drama Studio although we will be using that for the meeting on May 17th. The Caretakers at Uplands are always on hand and more than willing to help out if required.

We still carry out our "Outreach" visits to a variety of organisations including Schools, Guides, Scouts, the U3A and the Women's Institute. Please let us know if a group that you are involved with would benefit from a talk on basic Astronomy.

Lastly, I would like to offer my thanks to the Committee for their efforts in the past year. Phil has continued to book some excellent speakers, a number of which visited us for the first time. The next four meetings are all outside speakers, beginning with the entertaining Dr David Mannion who asks "ET, Are You Out There?"

John Lutkin looks after the Society's finances for which we are most grateful whilst John Wayte is not only Membership Secretary but is the person who parts visitors, so effortlessly, from their cash when they arrive. Geoff continues to produce a quality Newsletter month after month and maintains his contact with NASA who have, on a number of occasions, commented on how pleased they are for our support of NASA. Geoff would welcome any items that you would like to have published. Most important though is Jim Cooper, our Catering Manager, who makes sure the tea break leaves everyone fully refreshed. Incidentally, as I'm sure you're aware,

the tea, coffee and biscuits in the break are free and included in your membership (or visitor) fee which makes it such extremely good value.

Thank you all again for your support.

Brian Mills FRAS
Chairman
Wadhurst and District Astronomical Society

MEETINGS

JANUARY MEETING

The January meeting was led by our Chairman, Brian Mills who began by informing us that Phil Berry, our Secretary who normally introduces the meetings is in the middle of trying to move house which so often takes rather a long and traumatic time.

The Annual General Meeting

The January meeting always begins with our Annual General Meeting and following the Chairman's letter above, Brian introduced our Treasurer, John Lutkin to give his report.

John gave a statement of the Society's accounts for the year:

Income:
Membership and Visitor's fees £806

Expenditure:
Venue hire £270
Speakers fees £290
Equipment purchase £100
Administration expenses £43
Federation of Astronomical Societies fee £53
Total outgoing £756

Operating surplus £50

Accounts:
Balance 1 January 2016 £802
Operating surplus £50

Balance 1 January 2017 £852
Made up of:
Current account £759
Uncleared Deposit and Membership Secretary float £93

WAS Reserve Account 1 January 2016 £502
WAS Reserve Account 31 December 2016 £502

John concluded by saying that costs were continually rising and the Committee had proposed that the fees be raised. This proposal was put to the Members present and was unanimously passed, and are as laid out above under "2017 Subscriptions".

Finally, Brian asked if members were happy with the present Committee and members present voted unanimously to re-elect them.

Brian then introduced the first of tonight's short talks.

Adventures in Spectroscopy
John Lutkin

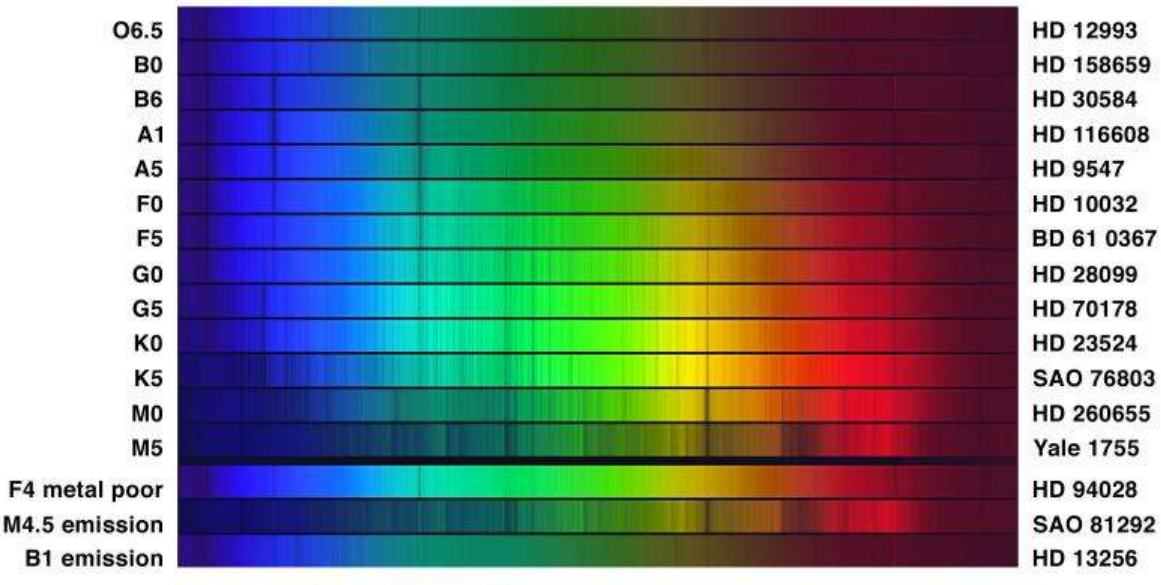
John produced an amusing insight into spectroscopy in his talk, starting with a quick explanation of how spectroscopy is applied in astronomy. It is used for the classification of stars and helps to tell them apart.

We first looked at the Stellar Spectral Classification system that uses letters to identify descending temperatures O, B, A, F, G, K, M but John freely admitted that he hadn't been able to find out why these letters were used. Each of these temperature classifications is followed by a number descending from 0 to 9 that gives a finer temperature range.

This classification is also followed by a Roman numeral to identify the luminosity:
0 – Hyper Giant
Ia – Bright Super Giant
Ib – Supergiant
II – Bright Giant
III – Giant
IV – Subgiant
V – Dwarf

For example, Vega is classified as A0V – temperature 9600K, luminosity = 37 Suns, mass = 2 Suns
And Deneb; A2Ia – temperature 8525K, luminosity = 54,000 Suns, mass = 20 Suns.

We were shown a diagram of examples of spectral star classifications from O to M of various stars.



Looking at the science side of the spectrum he started with the most seen example; a rainbow. But went on to the more practical splitting of light using a prism which refracts the light so that red, the longer wavelengths are refracted the least and blue, the most, separating white light into its spectral colours.

In passing, John referred to Pink Floyd's "Dark Side of the Moon" record cover which shows a prism separating light in the most improbable way; incorrect angles, no pink or violet and even on the back of the cover, light is shown converging…

Another way of separating the spectral colours is by using a diffraction grating which has several extremely narrow parallel slits. Here light passes through the grating and where the wave fronts cross on the other side, they interfere, producing the coloured bands

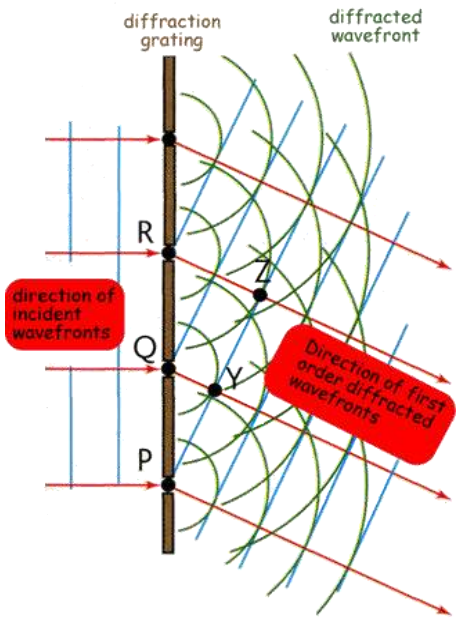
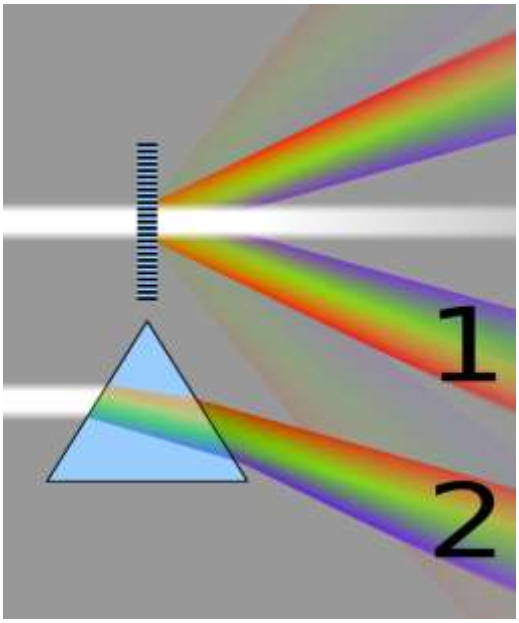


Diagram showing the interference pattern having passed through the grating



Comparing the diffraction grating with the prism

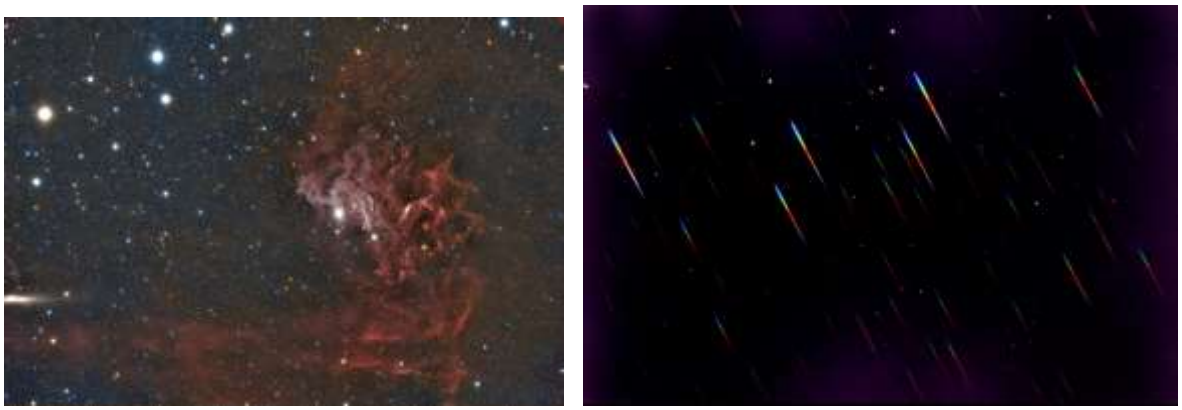
Now John turned to the practical side of looking at spectral lines.

Light from a star is pretty weak and one needs something like a DSLR camera plus a diffraction grating or a telescope with a focal ratio less the F4 to collect it.

A telescope needs a stable equatorially driven mount, and a guide cam such as a webcam would help with the fainter stars. The camera itself can be a webcam which has better quantum efficiency. The use of a DSLR is improved with the filter removed.

To look at the spectrum John used a star analyser he had been given but said that they are on the market for about £100. Then he suggested that the computer to collect the data need not be high spec and there is free software available such as Isis (Integrated Spectrographic Innovative Software).

If one is interested in going further John suggested the Shelyak Product Range.



Comparing the image of the Veil Nebula and looking at the same area spectroscopically

John finished by saying that Spectroscopy reveals a star's:
Chemical 'fingerprint' composition
Temperature
Mass
Surface gravity
Doppler effect

From the above, he said that spectroscopy is also a valuable tool in assessing exoplanets.

John concluded by saying that he is in the early stages of the subject but is finding it absolutely fascinating and an advantage is that pollution is not a problem.

The Magnitude Scale
Brian Mills FRAS

The second talk was given by our Director of Observations who began by saying that he often used star magnitudes in the Sky Notes and thought it would be a good idea to talk a little bit about them.

Looking at the history, Brian said Hipparchus 190 BC to 120 BC and Ptolomy 100 AD to 170 AD referred to the "Bigness" of stars rather than brightness and divided stars into 6 classes from the biggest (the brightest are nearest and therefore look bigger) to the dimmest (more distant and look smaller).

In the 16th century Tycho Brahe suggested that the stars had size and said that 1st magnitude stars were 2 arc minutes across and so on to 6th magnitude which he said were .33 arc minutes across.

Then as Brian said, along came the telescope and Hevelius (1611 to 1687) measured stars telescopically and stated that 1st magnitude stars were now 6 arc seconds across down to 6th magnitude stars at 2 arc seconds although Hevelius and others had been confused by the Airy disk which is caused by diffraction as it passes through the lens.

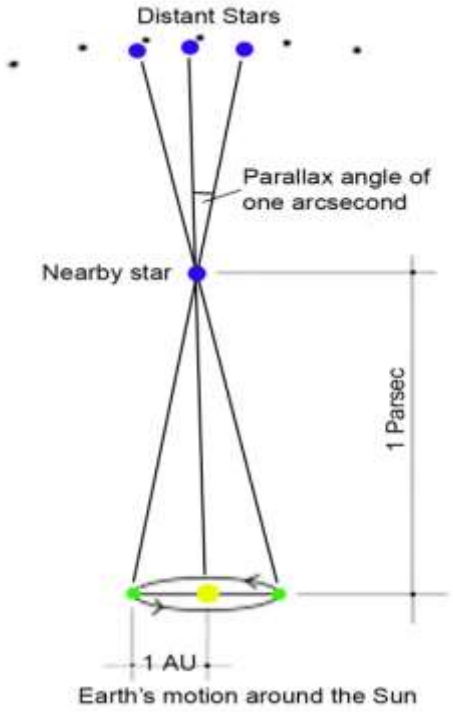
In 1838 Friedrich Bessel measured the parallax of the star, 61 Cygni and calculated it to be 10.3 light years away (now known to be 11.4 light years away) and stated that stars were point sources.

In the mid 19th century early photometric measurements were made comparing an artificial light source with actual stars and it was found that 1st magnitude stars were around 100 times brighter that 6th magnitude stars, then Brian told us that in 1856 Norman Robert Pogson proposed that a logarithmic scale be used so that one magnitude would be 2.512 brighter or dimmer than the next magnitude. ($\sqrt[5]{100}$).

This scale is extended to objects in the night sky brighter or dimmer than magnitudes 1 to 6. The full moon for example is about magnitude -12 and the Sun, about magnitude -27. At the other end of the scale the Hubble Space Telescope can see objects down to magnitude +30.

Up until now we have been talking about Apparent Magnitude; the magnitude we see from Earth.

Brian now talked about Absolute Magnitude; the true brightness of a star. To do this, the brightness of a star is calculated as if it were measured from1 Parsec away.

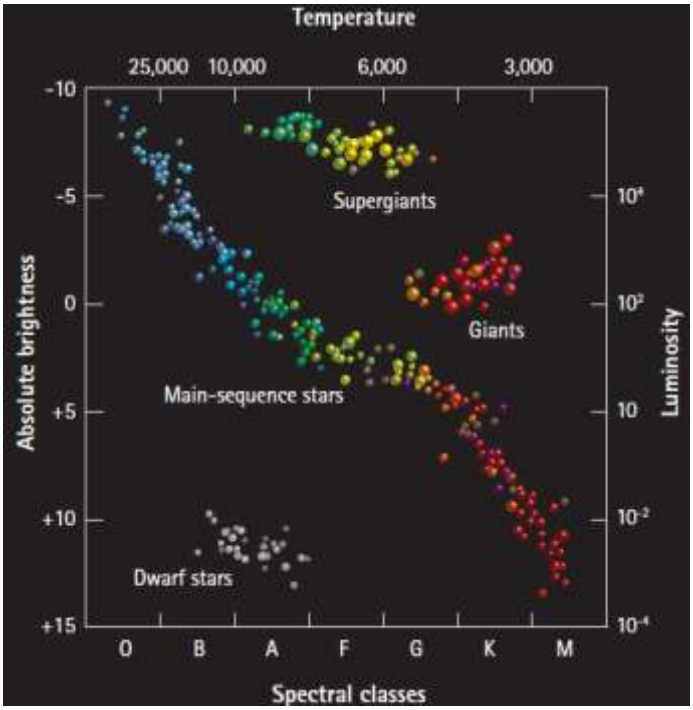


A Parsec is the distance at which the mean radius of the Earth's orbit subtends an angle of one second of arc.

Now all stars can be compared.

Brian said that there are also other methods of distance finding. In the late 19th century Henrietta Leavitt discovered the relationship between the period of a Cepheid Variable and its brightness and found a way of determining distance so that their Absolute Magnitude could be calculated.

Another method was to compare a star's surface colour on the Hertzsprung - Russell diagram and so determine its Absolute Magnitude



The Hertzsprung- Russell diagram

Finding the star's Absolute Magnitude from the chart and knowing the Apparent Magnitude, it is possible, using the Inverse Square Law to work out its distance.

Name	Apparent magnitude	Parallax "	Distance l.y.	Absolute magnitude
Sun	–26.78	—	—	4.82
Sirius	–1.46	0.37921	8.60	1.43
Canopus	–0.74	0.01055	309	–5.62
Arcturus	–0.05	0.08883	36.72	–0.31
Vega	0.03	0.13023	25.04	0.60
Rigel	0.13	0.00378	863	–6.98
Procyon	0.37	0.28456	11.46	2.64
Betelgeuse	0.4	0.00655	498	–5.52
Achernar	0.46	0.02339	139	–2.69
Altair	0.76	0.19495	16.73	2.21
Aldebaran	0.86	0.04894	66.64	–0.69
Antares	0.91	0.00589	554	–5.24
Spica	0.97	0.01306	250	–3.45
Pollux	1.14	0.09654	33.78	1.06
Fomalhaut	1.16	0.12981	25.13	1.73
Deneb	1.25	0.00231	1412	–6.93
Regulus	1.35	0.04113	79.30	–0.58
Castor	1.58	0.06412	50.87	0.6

A table showing the Apparent Magnitude, Parallax, Distance and Absolute Magnitude of various stars

We were very grateful to both speakers for their informative talks and preparing them so well for the meeting's changing circumstances.

Following the tea and coffee break Brian then gave the Sky Notes for the rest of January and for February. The February Sky Notes follow later in the newsletter.

FEBRUARY MEETING

15th February – Dr David Mannion gives another of his entertaining talks, this time he calls it "ET, Are You Out There?"

Meetings will take place in classrooms IL5 and 6 which are in the blue walled classroom block at the far end of the drive from the main gate of Uplands College and up by the tennis courts. Signs will direct you. There is car parking near the block. 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

15th March – Professor Louise Harra brings us the latest news of "Solar Activity".

19th April – William Joyce tells us about "Interacting and Active Galaxies"

17th May – **This meeting will take place in the Drama Studio** – The Science and Astronomy writer Colin Stuart sets out "13 Journeys Through Space and Time: Christmas Lectures From the Royal Institution"

SKY NOTES FOR FEBRUARY 2017

Planets

Mercury was at greatest elongation (West) in mid January when, even at it's furthest from the Sun, it was a difficult morning object. It is now moving back into the solar clutches and to all intents and purposes will be unobservable from the latitudes of the UK. It reaches superior conjunction on March 7th after which it moves east of the Sun to become an evening object.

Venus is a brilliant evening object, shining at magnitude -4.6 in the south west at sunset. The planet was at greatest elongation during January and currently sets nearly 4½ hours after the Sun meaning that it can be seen in a sky that is properly dark. Venus spends the month moving eastwards through the stars of Pisces in company with Mars until, around the middle of the month, they part company. Mars continues to the east but Venus moves back towards the Sun and an inferior conjunction in late March. The phase of the planet becomes an ever thinner crescent whilst at the same time its apparent size increases to almost 50" (50 arc seconds) by the end of the month. Due to the great brightness of Venus it can be easier to observe its phase during daylight providing you are careful not to look towards the Sun when using optical aid.

Mars, as mentioned above, spends the month moving direct through Pisces, that is apart from a brief sojourn into the north western corner of Cetus (the whale) on the 7th. Fig 1 shows the positions of Mars and Venus on a number of days during February. The map is drawn for 18.30 in the middle of the month. The brightness and apparent size of Mars both continue to fall as the distance between it and the Earth grows larger. There will be no opposition of Mars in 2017 as this only occurs every other year. The red planet, however, is in conjunction with the Sun in late July. On the 26th/27th Mars passes close to Uranus as mentioned a little later.

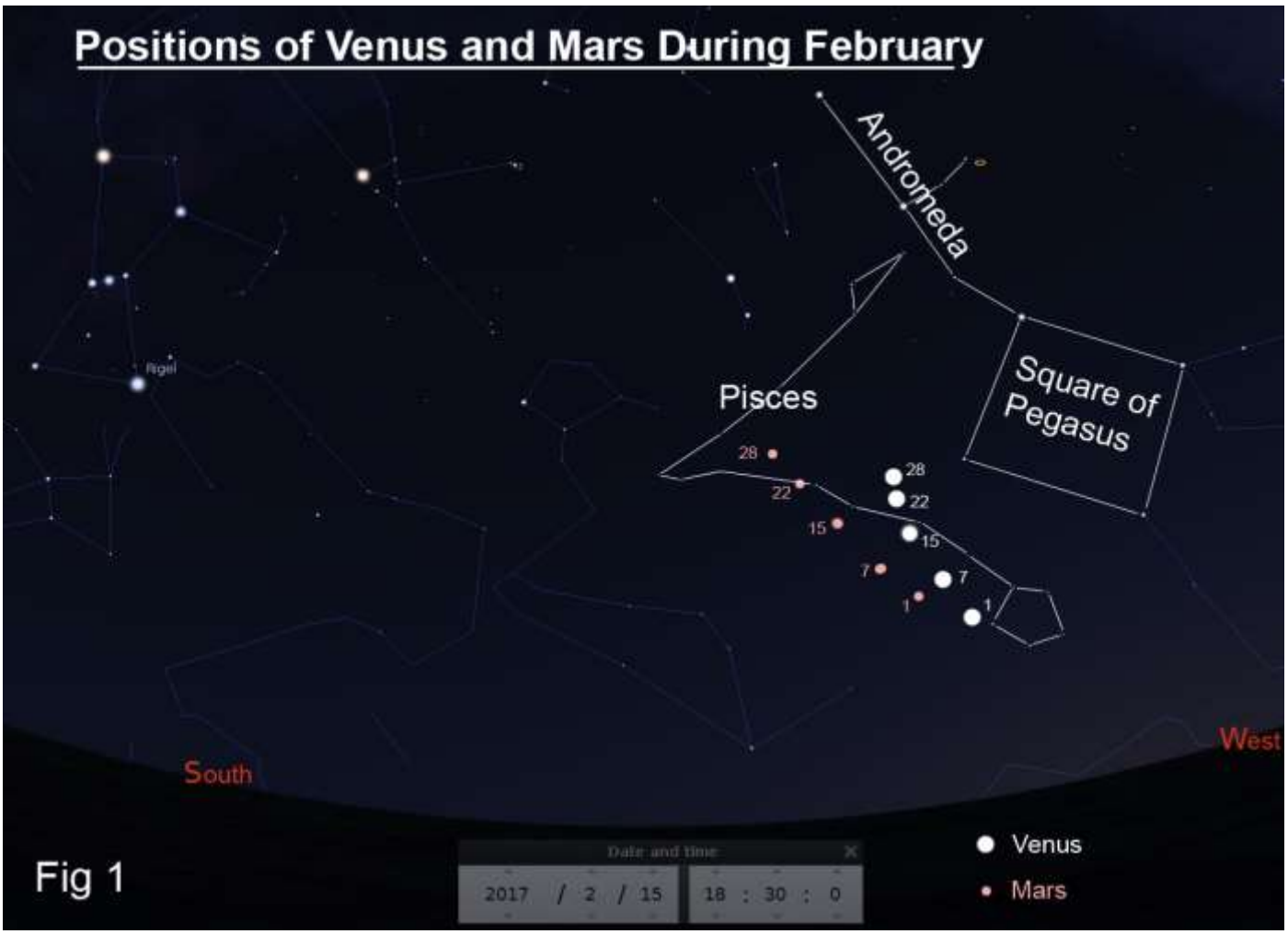


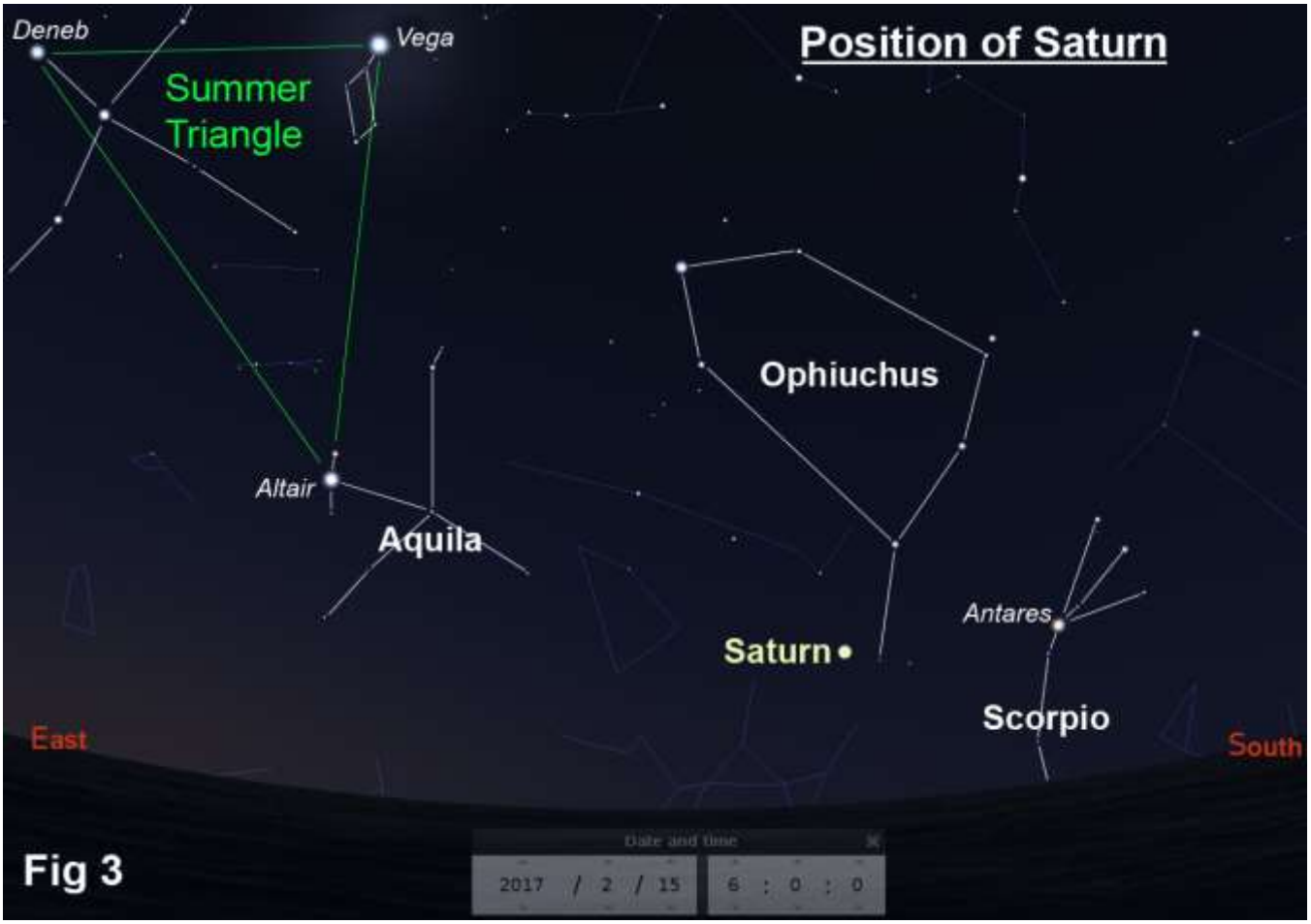
Fig 1

Jupiter begins the month moving eastwards in Virgo but reaches its first stationary point on February 7th after which it moves retrograde (east to west). At the beginning of the month, the planet rises at 23.15 although it is still best seen in the early morning when it has gained some altitude. It lies close to Spica, the brightest star in Virgo, as shown in Fig 2 which is drawn for 06.00 on the first of the month though Jupiter's position will change little over the course of 4 weeks. Use the tail of Ursa Major and Arcturus if you have trouble finding Jupiter.

Fig 2

The planets brightness is still climbing, albeit gradually now, as it is almost at maximum brilliance (of -2.4) for the coming opposition in early April. Its apparent size is now 42" (42 arc seconds) when measured around the equator but only 39" when measured around the poles. This equatorial bulge is formed by centrifugal force caused by the planet rotating in just less than ten hours. In terms of distance this means that Jupiter is more than 9,000 km longer around the equator.
Jupiter reaches opposition every 13 months or so which is the time taken for the Earth to orbit the Sun once and then “catch up” with Jupiter by the amount that the gas giant has moved on around its own orbit. During February Jupiter lies approximately 8° below the celestial equator, but in subsequent years as it moves along the ecliptic, it moves further and further below it. This means that the coming oppositions of Jupiter will see it lower in the sky and therefore viewed through an increasingly think and turbulent layer of the Earth’s atmosphere. It will be 2022 before Jupiter is back on the celestial equator during opposition.

Saturn is now becoming a little more obvious in the morning skies as it continues to draw away from the Sun. At the beginning of February it rises just before 05.00, but by month’s end this occurs just after 03.00. The planet spends most of the month in the southern part of Ophiuchus but moves eastwards across the border into neighbouring Sagittarius on the 25th. Sadly for us Saturn, like Jupiter, lies below the celestial equator although in the case of the ringed planet the situation is considerably worse with it having a declination of -22°. Saturn’s brightness remains constant at +0.5 although its angular size is growing as it approaches opposition in mid June. If you get the chance to observe it through a telescope, the rings are still really well presented to the Earth thanks to the planet’s north pole being tilted towards us at an angle of over 26°. The position of Saturn, a little to the east of the bright star Antares, is shown in fig 3.



Uranus isn't something that I cover very often, but it is included this month because on the 26th and 27th of February it is approached by Mars which passes a little to the west and north of it.

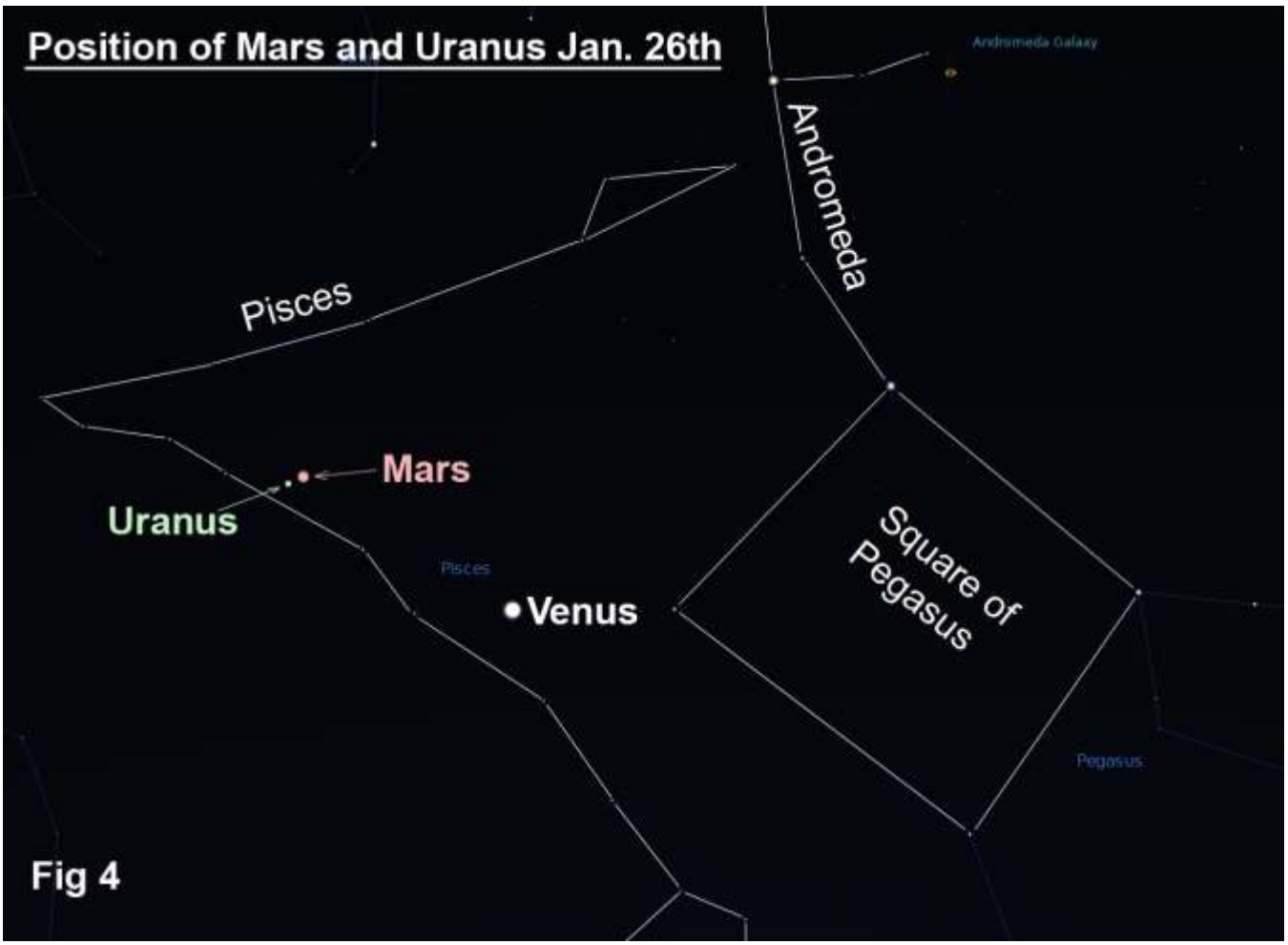


Fig 1 shows the overall position of Mars with fig 4 giving more detail to include where to look for Uranus on the evening of the 26th. The planet is currently magnitude +5.7 so is technically just visible to the naked eye from a dark sky site. If you use a telescope you may just be able to identify the tiny disk of the ice giant bearing in mind it has an angular diameter of under 4" (4 arc seconds). On the 27th Mars will be north of Uranus but by less than a degree.

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. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. The Moon passes through the Hyades cluster on February 5th causing multiple events which involve reasonably bright stars. **Times are in GMT.**

Feb	Time	Star	Mag	Ph	Alt °	% illum.	mm
Feb 02	19.03	ZC 249	4.4	DD	37	34	40
Feb 03	23.35	ZC 405	4.3	DD	10	47	40
Feb 04	18.03	ZC 508	4.1	DD	51	57	40
Feb 05	16.32	ZC 661	4.5	DD	41 (Sun +3°)	67	100
Feb 05	17.47	ZC 671	3.4	DD	50	68	40
Feb 05	17.49	ZC 669	3.8	DD	50	68	40
Feb 05	19.08	ZC 680	6.5	DD	55	68	60
Feb 05	19.09	ZC 677	4.8	DD	55	68	40
Feb 05	19.38	ZC 682	6.0	DD	55	68	50
Feb 05	20.48	ZC 685	6.6	DD	52	69	70
Feb 05	23.07	ZC 699	5.8	DD	35	70	50
Feb 08	23.00	ZC 1158	5.0	DD	56	95	40

Phases of the Moon for February

First ¼	Full	Last ¼	New
4th	11th	18th	26th

ISS

Below are details for passes of the International Space Station (ISS). The details of all 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 GMT.**

Feb	Time	Mag.	Alt°	Az.		Feb	Time	Mag.	Alt°	Az.
1st	18:09:48	-2.2	30°	SSE		7th	19:20:31	-2.6	53°	W
2nd	18:53:44	-3.4	71°	SSE		8th	18:28:45	-3.4	83°	N
3rd	18:01:24	-2.9	51°	SSE		9th	17:36:17	-3.3	78°	N
4th	18:45:25	-3.4	87°	N		9th	19:12:41	-3.0	60°	SSW
5th	17:53:02	-3.3	77°	SSE		10th	18:20:19	-3.3	79°	SSW
6th	18:37:07	-3.4	78°	N		11th	19:04:09	-2.1	37°	SSW
7th	17:44:40	-3.3	84°	N		12th	18:11:46	-2.7	53°	SSW

Iridium Flares

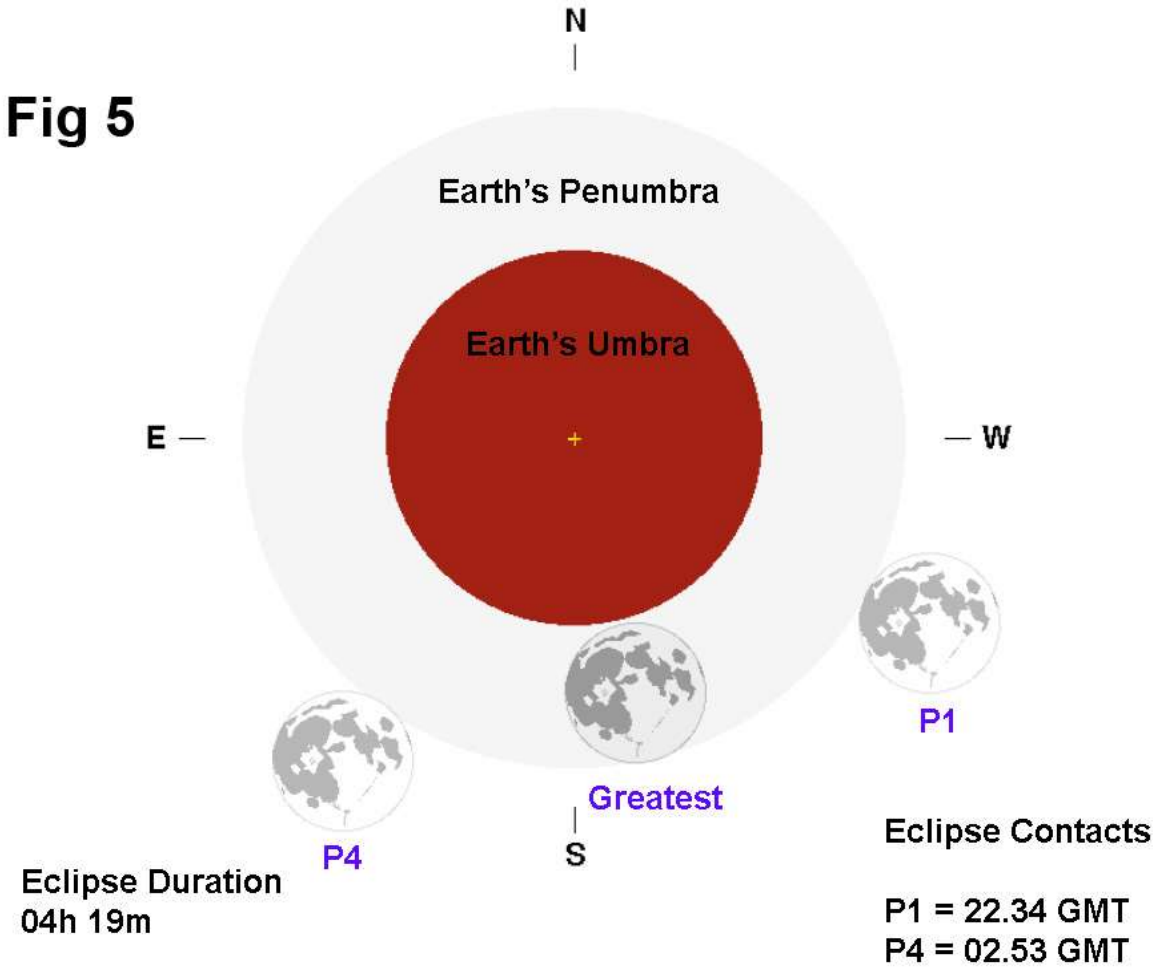
The flares that I've listed are magnitude -2.0 or brighter although there are a lot more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . When one of these events is due, it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter then. **Times are in GMT.**

Feb	Time	Mag	Alt°	Az.°		Feb	Time	Mag.	Alt°	Az.°
2nd	18.17	-6.2	53°	29° (NNE)		12th	17.25	-3.2	72°	34° (NNE)
3rd	18.11	-5.4	56°	29° (NNE)		15th	19.12	-7.1	38°	17° (NNE)
8th	19.46	-3.2	23°	15° (NNE)		19th	19.29	-5.2	46°	128° (SE)
9th	19.40	-2.4	25°	16° (NNE)		22nd	18.38	-5.0	51°	16° (NNE)
10th	19.34	-3.0	28°	17° (NNE)		24th	18.25	-6.3	55°	17° (NNE)
11th	17.31	-3.6	70°	33° (NNE)		24th	19.08	-8.1	51°	142° (SE)

Penumbral Eclipse of the Moon

On the night of February 10th/11th there will be a penumbral lunar eclipse. This occurs when the Moon passes into the shadow that is always cast out into space by the Earth. On this occasion, sadly, the Moon does not pass through the central shadow, the umbra, but only passes through the fainter outer shadow known as the penumbra. This means that the effect is not nearly so dramatic and, in

fact, it would be easy to glance at the Moon and not realise a penumbral eclipse was in progress as the change in appearance is so subtle. Fig 5 shows the path of the Moon though the shadow and also the times of the start and end of the event.



The Night Sky in February (Written for 22.00hrs GMT mid month)

In the south the faint constellation of Lynx lies close to the zenith, whilst below it Cancer and the open cluster M44 are approaching the meridian. The head of Hydra is also nearly due south, though the last vestiges of its tail will not clear the horizon for several more hours. In that region M83, the Southern Pinwheel galaxy, can be found though it is always going to be a challenge, culminating with an altitude of just 9° from the south of England. Also to be found low down towards the south is the northern half of the constellation Puppis which forms the poop deck, or stern, of the original Argo Navis. The most prominent of its stars visible from the UK is ρ (rho) Puppis at magnitude +2.8 which currently can be found 14° above the horizon. There are a number of open clusters in the area, the brightest of which is M93 at magnitude +6.2. Just to the west lie some members of Orion's retinue, namely Canis Major, whose brightest star Sirius has passed its best, and Lepus. Above them we find the faint and shapeless form of Monoceros (the unicorn) that is home to NGC 2264, a designation that encompasses the Cone Nebula and Christmas Tree Cluster. The Cone itself is a difficult visual object although a UHC filter can help.

Turning to the west Orion and Taurus are approaching the horizon although both Betelgeuse and Aldebaran are just over 40° in altitude whilst Capella in Auriga is more than 60°. Below Capella, Perseus and the double cluster are still well placed as are a number of other open clusters in the area. One of the more memorable is M34, with an estimated 400 members, which lies close to the border with Andromeda. Pegasus and Pisces are now all but set and soon to be followed by Andromeda itself along with Triangulum and Aries that lie between the celestial Queen and the head of the whale.

Looking north we find that the only circumpolar member of the Summer Triangle, Deneb, is just above the northern horizon, whilst the brightest of the three, Vega, is visible some 25° to the east but very low down. Cepheus and Draco lie below the pole and either side of the meridian; Cepheus to the west and Draco to the east. Cepheus contains NGC 7023, sometimes referred to as C4 or Caldwell 4, but better known as the Iris Nebula, a moderately bright reflection nebula that shines at magnitude 6.8. Ursa Major is still climbing and will soon be close to the zenith providing an excellent opportunity to image M81, Bode's Galaxy, at an altitude of some 60°. It is a magnitude 6.9 spiral galaxy that was discovered by Johann Bode in 1774 and was home to a supernova in March 1993. Its near neighbour is M82 which is known to be a "starburst" galaxy where star formation is taking place at a rate far in excess of that in the Milky Way. A DSLR camera used with a F6 refractor or similar provides a pleasing wide angle vista and will include NGC 3077 as a bonus.

Towards the east Virgo, that currently contains the planet Jupiter, is just rising as is Boötes and Corona Borealis. Hercules is now appearing with M13 and M92, two bright globular clusters, though don't forget M3 and M53 in Canes Venatici and Coma Berenices respectively.

Brian Mills

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Comet Campaign: Amateurs Wanted
By Marcus Woo

In a cosmic coincidence, three comets will soon be approaching Earth—and astronomers want you to help study them. This global campaign, which will begin at the end of January when the first comet is bright enough, will enlist amateur astronomers to help researchers continuously monitor how the comets change over time and, ultimately, learn what these ancient ice chunks reveal about the origins of the solar system.

Over the last few years, spacecraft like NASA's Deep Impact/EPOXI or ESA's Rosetta (of which NASA played a part) discovered that comets are more dynamic than anyone realized. The missions found that dust and gas burst from a comet's nucleus every few days or weeks—fleeting phenomena that would have gone unnoticed if it weren't for the constant and nearby observations. But space missions are expensive, so for three upcoming cometary visits, researchers are instead recruiting the combined efforts of telescopes from around the world.

"This is a way that we hope can get the same sorts of observations: by harnessing the power of the masses from various amateurs," says Matthew Knight, an astronomer at the University of Maryland.

By observing the gas and dust in the coma (the comet's atmosphere of gas and dust), and tracking outbursts, amateurs will help professional researchers measure the properties of the comet's nucleus, such as its composition, rotation speed, and how well it holds together.

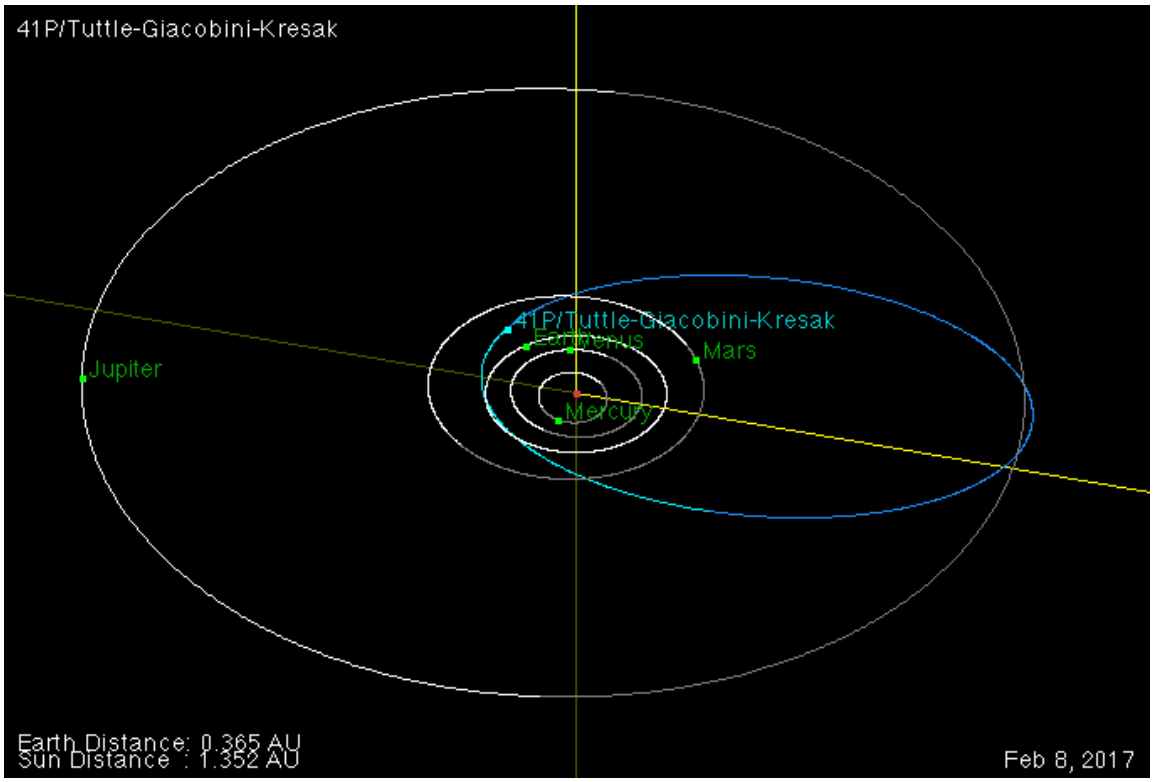
The observations may also help NASA scout out future destinations. The three targets are so-called Jupiter family comets, with relatively short periods just over five years—and orbits that are accessible to spacecraft. "The better understood a comet is," Knight says, "the better NASA can plan for a mission and figure out what the environment is going to be like, and what specifications the spacecraft will need to ensure that it will be successful."

The first comet to arrive is 41P/Tuttle-Giacobini-Kresak, whose prime window runs from the end of January to the end of July. Comet 45P/Honda-Mrkos-Pajdusakova will be most visible between mid-February and mid-March. The third target, comet 46P/Wirtanen won't arrive until 2018.

Still, the opportunity to observe three relatively bright comets within roughly 18 months is rare. "We're talking 20 or more years since we've had anything remotely resembling this," Knight says. "Telescope technology and our knowledge of comets are just totally different now than the last time any of these were good for observing."

For more information about how to participate in the campaign, visit http://www.psi.edu/41P45P46P.

Want to teach kids about the anatomy of a comet? Go to the NASA Space Place and use Comet on a Stick activity! http://spaceplace.nasa.gov/comet-stick/



An orbit diagram of comet 41P/Tuttle-Giacobini-Kresak on February 8, 2017—a day that falls during the comet's prime visibility window. The planets orbits are white curves and the comet's orbit is a blue curve. The brighter lines indicate the portion of the orbit that is above the ecliptic plane defined by Earth's orbital plane and the darker portions are below the ecliptic plane. This image was created with the Orbit Viewer applet, provided by the Osamu Ajiki (AstroArts) and modified by Ron Baalke (Solar System Dynamics group, JPL). http://ssd.jpl.nasa.gov/sbdb.cgi?orb=1;sstr=41P

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Any material for inclusion in the March 2017 Newsletter should be with the Editor by February 28th 2017