




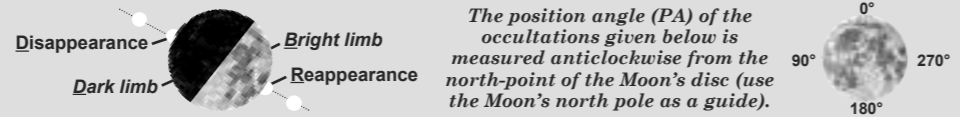
### Moon phases

	<b>Last quarter</b> 30 Nov, 00:19 29 Dec, 09:34		<b>New</b> 07 Nov, 16:02 07 Dec, 07:20		<b>First quarter</b> 15 Nov, 14:54 15 Dec, 11:49		<b>Full</b> 23 Nov, 05:39 22 Dec, 17:49
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### Apsides

Date	Apsis	Dist (km)	Size	Date	Apsis	Dist (km)	Size
14 Nov, 16h	Apogee	404,339 km	29' 33"	12 Dec, 12h	Apogee	405,177	29' 29"
26 Nov, 12h	Perigee	366,620 km	32' 35"	24 Dec, 10h	Perigee	361,061	33' 06"

### Occultations



These are the only occultations for this period, based on the following criteria: *Mag*: Visual magnitude. *Phase*: (R)eappearance, (D)isappearance or (G)raze at (D)ark or (B)right lunar limb. *Alt*: Altitude. *The Moon's height*. *Az*: The angular position along the horizon measured clockwise from true north (through E, S, W back to N). *PA*: Position Angle, measured anticlockwise from the direction of the celestial North Pole. This listing shows lunar occultations of stars brighter than mag +6, observable with small telescopes in a sky dark enough to be seen without difficulty. For data specific to your own locality or details of fainter occultations, contact Occultation Section Director Mell Jeffery (address on p46).

Date	Name	ZC	Mag	Phase	Data for Greenwich				Data for Edinburgh			
					Time	PA°	Alt°	Az°	Time	PA°	Alt°	Az°
21-Nov	mu Ceti	405	4.3	DD	20h 48m	55	43	140	20h 54m	44	39	141
25-Nov	chi 1 Orionis	894	4.4	RD	06h 16m	252	28	267	06h 10m	261	31	261
27-Nov	85 Geminorum	1193	5.4	RD					04h 15m	221	53	192
27-Nov	Asellus Australis, delta Cancri	1310	3.9	RD					22h 34m	222	15	80
30-Nov	53 Leonis	1576	5.3	RD	03h 25m	263	37	125	03h 27m	276	33	124
19-Dec	xi 2 Ceti	364	4.3	DD	00h 44m	138	24	252	00h 26m	112	27	243
19-Dec		462	6	DD	18h 21m	90	37	121	18h 24m	80	33	122
21-Dec	63 Tauri, NSV 15964	650	5.6	DD	03h 29m	123	22	270	03h 18m	110	25	263
21-Dec	104 Tauri	764	4.9	DD	19h 23m	133	35	105	19h 21m	116	32	105

### Occultation notes

For this particular 2-month period there are several occultations which will be difficult to observe due to star magnitude and lunar phase. For example, 104 Tauri is occulted by the dark limb on 21 December by a 99 per cent illuminated moon. In situations like this it is best to keep as much of the lunar limb out of the field of view of the eyepiece.

There are also two grazes this period and both occur approximately 18 hours apart on the same day, 27 November (see page 41). The first of these events is that of 5.4 magnitude 85 Gemini and an occultation, a reappearance at the dark limb of an 80 per cent illuminated waning gibbous moon, is seen north of the grazepath, which in Edinburgh is at 04h 15m. The path starts on the Welsh coast and cuts inland north of Llanllyfni, passes across country and to the south of

Stafford, through the north of Leicester, south of Peterborough, travels between Mildenhall and Thetford and then out to sea north of Leiston.

The second graze is of 3.9 magnitude Asellus Australis (delta Cancri) and is the brightest star to be occulted during November and December using the SPA criteria. This even is also a reappearance at the dark limb of the moon which is now 72% illuminated. Yet again, north of the grazepath an occultation will be observed, for Edinburgh at 22h 34m. Starting in the west the path grazes the coast line of Cornwall at Crackington Haven, then in land to the south of Bude. It travels across Devon just south of South Molton and south of Watchet. It then cuts across the Bristol Estuary and back over land north of Burnham-on-sea. It passes south of Bristol and through Keynsham, North of Swindon and Oxford before cutting between Bletchley and Leighton Buzzard then out to sea north of Caister-on-sea.

Mell Jeffery

### Meteor notes

**The Leonids:** November sees the return of the Leonid meteor shower, a stream of comet dust that can fill the sky with 'shooting stars' every 33 years or so. Sadly, we are a long way from one of those 'storms', and peak rates (the ZHR) in 2018 are expected to reach just 10–15 an hour for a single observer.

However, the Leonids are still well worth observing you could see one or more of the beautiful fireballs that can occur. Bright Leonids often leave persistent trains in their wake. The main window of activity for Leonids lasts from 14–21 November with a peak on the night of 17/18 November. The Moon will be just past First Quarter but will have set at around 02:00 local time on the night of maximum, leaving a dark sky for the rest of the night.

**The Taurids:** You may still see Taurid meteors in November. Rates for these relatively slow-moving meteors peak at a ZHR of only 10 or so, but they often produce fireballs.

**The Geminids:** December offers a great opportunity to watch the richest meteor shower of the year, the Geminids. Activity runs from 7–16 December, with a peak on 14 December when rates should reach a ZHR of 100–120 meteors an hour. Best nights to observe will be 13/14 and 14/15 December. Moonlight will not be a problem as the Moon will be around First Quarter, setting in late evening on 15 December.

**The Ursids:** The Ursid meteor shower will be washed out by moonlight this year. Peak activity is expected to reach only 10 meteors an hour on the night of 22/23 December when the Moon will be Full.

Paul Sutherland

### Planets

On 6 November, Mercury reaches its greatest eastern (evening) elongation of 23 degrees from the Sun. This will be a good apparition from the southern hemisphere but very poorly seen from UK latitudes. To us the planet will be very low on the western horizon after sunset, in the first week of November, but is then lost, to reappear in the morning sky in December. On the 15th of that month Mercury reaches greatest western (morning) elongation, separated from the Sun by 21 degrees. For a week either side of this date, look for Mercury rising in the south-east from around 06:20 UT and follow it as it rises into daylight, gaining around 10 degrees of elevation by sunrise. Mercury is in close company with Jupiter around this time. On the 21 to 23 December the pair rise at almost the same time and only one degree apart.

Venus rises higher in the south-eastern sky with each morning of this period but is best viewed from late November and into December when it will gain more than 25 degrees of elevation by sunrise. It can easily be followed into daylight. On 1 December it will shine at a brilliant magnitude -4.65 and show a narrow 26 per cent illuminated phase. By Christmas this will be more than 43 per cent illuminated and at a similar brightness. An excellent target for observation in this period, the planet can reveal significant cloud detail when imaged in ultraviolet light with a suitably sensitive camera.

Mars, however, is a fading evening object in this period. Its brightness falls from magnitude -0.6 to +0.47 and its visible size from 12 to 7.4 arcseconds but Mars will remain an excellent observing target for UK observers. Due to the rise of the ecliptic as we move towards mid-winter, Mars gains significant elevation as darkness falls and can be seen higher in the sky than at opposition back in July. In early November Mars transits due south around 19:00 UT at more than 20 degrees of elevation; by mid-period the transit time is 18:15 UT at nearly 30 degrees up and by New Year's Eve Mars transits in evening twilight at more than 35 degrees of elevation. On 7 December, look for Mars as darkness falls and find

Neptune in the same eyepiece view, only 6 minutes of arc to the south and west.

Jupiter is in conjunction with the Sun on 26 November so is initially unobservable; it then moves into the December morning sky. Look for its conjunction with Mercury in late December then follow it into daylight for observation at higher altitudes.

In early November Saturn may be found low in the south-west as darkness falls, and observed until it sets around 2 hours after the Sun. It draws steadily closer to the Sun as the period progresses and will effectively be lost to observation in late November.

Uranus will be slightly past its opposition as the period starts so is observable throughout the night, rising high in the sky against the background stars of Pisces. Look for its 3.7 arcsecond disc just 2.5 degrees east of the star Torcularis Septentrionalis (Omicron Piscium), a magnitude +4.2 star close to the tail of the easterly branch (or fish) of this 'V' shaped constellation. Uranus will be at the edge of naked eye visibility but will be obvious in binoculars as a slightly defocused green star and will reveal its disc to a telescope with moderate to high magnification. Now a popular imaging target, Uranus will transit at 23:15 UT in early November, 21:15 UT mid-period and 19:25 UT as the year closes. At nearly 50 degrees of elevation from mid-UK latitudes it is very well placed for imaging. Colour cameras will show a blue-green disc with subtle shading from equator to pole and monochrome cameras with infrared filters may catch storm features in its atmosphere.

The same is true of Neptune but its slightly smaller disc only shines at magnitude +7.85 so will be harder to find against the stars of eastern Aquarius; look for it 2 degrees east of Hydor (Lambda Aquarii). In early November it transits at around 20:30 UT with 30 degrees of elevation so can be observed comfortably through the evening and into the early hours. Mid-period, transit is at 18:25 UT and by Christmas the transit is at 17:00 UT, still with 30 degrees of elevation.

Alan Clitherow

### Variable star notes

**Eclipsing Variables:** Over the course of November and December there will be several opportunities to observe both RZ Cas and Algol (beta Persei). In November RZ Cas will be in eclipse on the evenings of 2, 8, 14, 20 and 26 November. The times of mid-eclipse will be approximately 23:00 UT, 22:00 UT, 22:00 UT, 21:00 UT and 21:00 UT respectively. During December there will be four more evening eclipses on the evenings of 2, 15, 21 and 27 December. The approximate times of these eclipses will be 20:00 UT, 23:00 UT, 23:00 UT and 22:30 UT respectively.

There will one favourable eclipse of Algol on the 14 of November at approximately 22:00 UT. A second favourable eclipse of Algol takes place on the evening of 27 December at 22:30 UT.

**Mira-Type Variables:** Several long-period variables will be reaching maximum over the course of November and December. Both Mira (omicron Ceti) and chi Cygni will be

on the rise in November and reaching maximum in December. Mira can be as bright as the third magnitude at maximum and chi Cygni can be as bright as the fifth. Both stars can be seen with the naked eye from a darksky site, although most observers will require binoculars to see them. Both S and T Ursae Majoris will at maximum in November, when they will be visible in binoculars. They will be fading over the course of December. T Cephei, R Trianguli and R Ursae Majoris will all be rising over the next few months, with R Trianguli an R Ursae Majoris reaching maximum in February, so should be starting to become visible in binoculars.

Meanwhile, U Orionis will reach minimum at the end of November and at will only be visible in large telescopes. However, it is rising over the course of December and will reach maximum in January, when it should be visible in binoculars at around the sixth magnitude.

Matthew Barrett