Australian Astronomy

ASA Factsheet No. 27

Total Eclipse of the Moon
Wednesday 8 October 2014

General Information

Figure 1 – The partial phase of the 15 April 2014 eclipse of the Moon. Photo Nick Lomb

A total eclipse of the Moon takes place on the evening of Wednesday 8 October. The Moon starts moving into the Earth's shadow at 8:15 pm Australian Eastern Daylight Saving Time (AEDT) and is fully immersed in the shadow at 9:25 pm. Totality is over at 10:25 pm and the eclipse ends at 11:35 pm. For people in the eastern half of Australia and New Zealand the whole eclipse is visible, while for people in the west the eclipse starts with the rising of the partially eclipsed moon.

A total eclipse takes place when the Moon moves into the shadow of the Earth. Although according to simple geometry it should then be completely dark, some red sunlight is bent onto the Moon by the Earth's atmosphere.

Scientists are always interested to see how dark and how red the Moon becomes during totality as that is an indication of atmospheric conditions. **Viewing an eclipse of the Moon is perfectly safe.**

Everyone who can see the Moon will see the eclipse simultaneously. However, because of the differences between time zones, local times of the event will be 30 minutes earlier in South Australia than the times quoted above and three hours earlier in Western Australia.

Table 1 shows the local times of different stages of the event.

Place	Eclipse begins	Totality begins	Totality ends	Eclipse ends
NSW/Vic/Tas/ACT	8:15 pm	9:25 pm	10:25 pm	11:35 pm
Queensland	7:15 pm	8:25 pm	9:25 pm	10:35 pm
South Australia	7:45 pm	8:55 pm	9:55 pm	11:05 pm
Northern Territory	6:45 pm	7:55 pm	8:55 pm	10:05 pm
Western Australia	moonrise (Perth 6:19 pm)	6:25 pm	7:25 pm	8:35 pm
New Zealand	10:15 pm	11:25 pm	12:25 am*	1:35 am*
*All times are in local time for 8 October 2014 (except times denoted with * for 9 October)*				

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Watching the event

Unlike a solar eclipse, a lunar eclipse is quite safe to observe with the unaided eye, binoculars or telescopes. The times mentioned in this factsheet (see Table 1) refer only to the passage of the Moon through the Earth's main dark, circular shadow called the *umbra*. Surrounding the umbra, there is a lighter region of shadow called the *penumbra*, through which the Moon also passes. However, except when the Moon's edge is very close to the umbra, it is very difficult to notice any changes or dimming of the Moon's disc due to the penumbra as in this region the Moon still receives some direct sunlight.

Lunar eclipses can be watched individually, but some people may rather do so in a group with telescopes and expert commentary available. A number of places around Australia offering eclipse viewing are listed at http://apsplanetarium.com/2014/09/24/total-lunar-eclipse/.

Lunar eclipse photography

Digital cameras are ideal to photograph the Moon, but a tripod is necessary to ensure sharp images, especially during totality. The maximum possible optical zoom should be used to give a reasonable size image.

Alternatively, it is possible to hand-hold a small digital camera or even a smartphone camera in front of the eyepiece of a telescope. With care to make sure that the camera is in the right position, some surprisingly good results can be achieved.

Why does the Moon turn red during totality?

Geometrically, the Moon should become completely dark during an eclipse as it is completely within the dark shadow of the Earth. The reason why some light, and usually reddish light, lands on the Moon is that some light reaches it through the Earth's atmosphere.

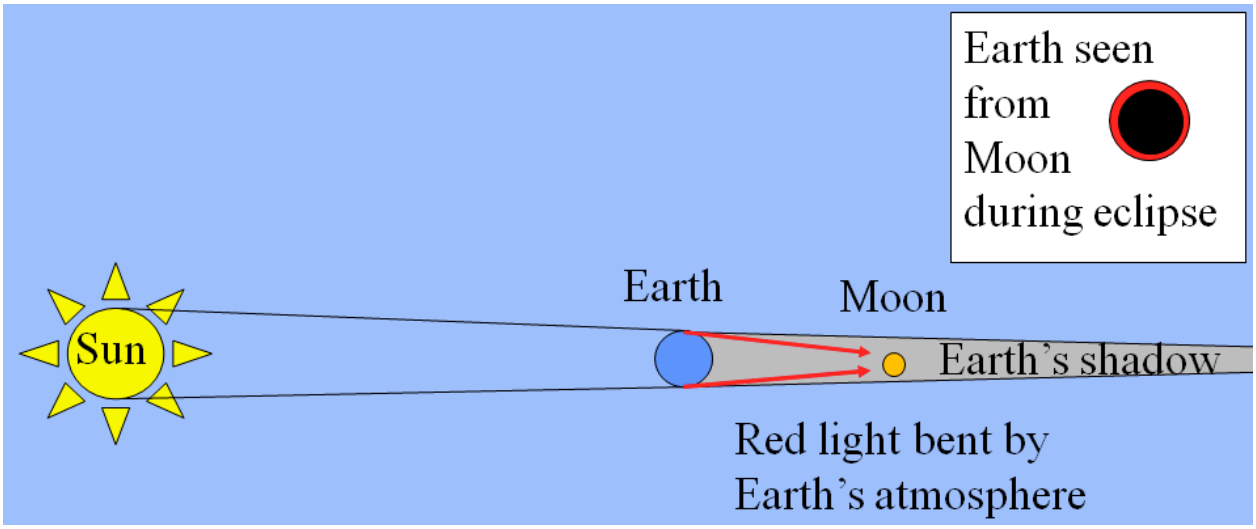

Figure 2 – The geometry of an eclipse of the Moon with the insert showing an astronaut's view of the Earth during an eclipse. Drawing Nick Lomb

Light is bent or refracted as it passes through materials of different density, for example, as it passes from water into air or from air to glass. Similarly, as the Earth's atmosphere is less dense at the top and becomes increasingly dense towards the Earth's surface, it also

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bends light passing through it. This means that during an eclipse some sunlight is bent towards the Moon.

The light reaching the Moon is red for the same reason that sunset is red, that is, blue light is scattered out of the beam of sunlight and what is left is red. There is also some light that is scattered towards the Moon, but under the condition of a reasonably clear atmosphere that light makes only a small contribution to the overall brightness of the Moon.

If there has been a recent volcanic eruption that places lots of small particles in the atmosphere, the situation is different. In eclipses of the Moon occurring in the years following the 1991 eruption of Mt Pinatubo in the Philippines, the amount of bent light transmitted through the atmosphere dropped by a factor of over a thousand, while the scattered light was slightly increased. Hence under those circumstances the two methods of transmission became comparable, at least in visible light, and the eclipsed Moon appears darker and greyer than at other eclipses.

The brightness and the colour of the Moon during a total eclipse, and how these vary across the disc, depend on factors such as the cloudiness in the regions of the Earth where it is dusk or dawn as well as the amount and size of dust particles suspended in the atmosphere. Hence to atmospheric scientists a total eclipse of the Moon provides a rare opportunity to study the state of the atmosphere in some detail.

Lunar eclipses in history

Both solar and lunar eclipses have significant places in history. Long ago, the Greek astronomer Aristotle used lunar eclipses to support the argument that the Earth is round for he noticed, as anyone can do during the 8 October eclipse, that the shadow of the Earth falling onto the Moon is curved.

In August 413 BCE, the Syracusan navy destroyed an Athenian fleet after its leader delayed a retreat because of a lunar eclipse, which was seen as a bad omen. Almost two thousand years later, the defenders of Constantinople in 1453 were so frightened by a partial lunar eclipse that the fall of the city was hastened.

In 1504, Christopher Columbus and his crew were marooned in Jamaica and the natives were no longer supplying them with food. According to his son Ferdinand, Columbus told the natives that his powerful god would make his anger clear by making the Moon 'appear inflamed with wrath, denoting the evils that God would inflict upon them', on the night of February 29. Columbus, of course, knew that a total lunar eclipse would occur on that date. This solved the problem, with the natives being so frightened that they promised to satisfy Columbus' future needs.

Recent and forthcoming eclipses

The most recent lunar eclipse visible from Australia and New Zealand, a total one, was earlier this year on the evening of Tuesday 15 April. The next will be on the evening of Saturday 4 April 2015; it will also be total, but unusually, only for a few minutes. This sequence of total eclipses of the Moon will end with a fourth one on Monday 28 September 2015 that will take place during daytime in Australia and New Zealand and so will not be visible from either country.

Reference

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García Muñoz A, Pallé E. *Lunar eclipse theory revisited: Scattered sunlight in both the quiescent and the volcanically perturbed atmosphere.* JQSRT (2011), doi:10.1016/j.jqsrt.2011.03.017.

This information was prepared for the ASA by Dr Nick Lomb, the author of the annual Australasian Sky Guide, the 2015 edition of which will be available in late October. Martin George of the Launceston Planetarium (http://www.qvmag.tas.gov.au/qvmag/?c=23) contributed to previous lunar eclipse factsheets and his help is acknowledged. This sheet may be freely copied for wide distribution provided the Australian Astronomy and ASA logos are retained.

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