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## A COSMIC COINCIDENCE

Ken Tapping, 1<sup>st</sup> August, 2017

The Moon's distance from us is about 110 times its diameter. The Sun's distance is also about 110 times its diameter. That means that despite being very different in size (the Moon has a diameter of about 3500 km and the Sun a diameter of about 1.4 million km), they look the same size in the sky. Consequently, when the Moon gets precisely between the Earth and Sun, there will be a location on Earth where an observer will see the Moon completely covering the Sun. These events are known as eclipses of the Sun. As the Moon moves across the face of the Sun, that special location will move across the surface of the Earth.

If the Moon and Sun are exactly the same size in the sky, the moment the Sun is entirely covered will be very short. However, if the Earth is at the point in its orbit most distant from the Sun and the Moon is at the point in its orbit where it is closest to Earth, an observer at the right location will see the Sun covered for longer, up to several minutes. There is usually at least one solar eclipse visible somewhere on Earth every year, but at any single location eclipses can be separated by decades.

Astronomers are interested in eclipses because when the blindingly bright solar disc – the photosphere -- is covered by the Moon, we can observe parts of the Sun that are otherwise hidden in the glare, such as the solar chromosphere, filled with glowing red loops and arches of magnetized plasma, and above that the corona, a part of the Sun that is X-ray hot. We are still puzzled by how the corona, heated by the 6,000 Celsius photosphere, with cold space above it, can have a temperature of over a million degrees Celsius. It is as weird as putting a steel poker in a fire, having the end in the fire go red hot, and the end out of the fire – the handle end – melt. Physics says that can't happen. Many people go to enjoy solar eclipses because of the sheer spectacle. The thrill of solar eclipses can be highly addictive.

The Earth and other planets orbit the Sun in the same plane, like marbles rolling on an invisible

plate. From our position on one of the marbles/planets, we see the Sun and the other planets move to and fro along a fixed path in the sky, which we call the ecliptic. We have identified 12 constellations through which the ecliptic passes. These are known as the Signs of the Zodiac. The Moon's orbit is at an angle to the ecliptic, so although we see a Full Moon every time the Sun, Earth and Moon are more or less in line, having them precisely in line is much rarer. We need the Moon to be Full when it is crossing the ecliptic. This will happen this year, on 21 August. The path of total coverage will cross the USA. In Canada we will see the Sun only partially covered. Even so, plan to enjoy the event.

A few years ago there was a total eclipse of the Sun visible from England. Observers on the tip of Cornwall would see the whole Sun covered. I was in England at the time visiting friends. The weather forecast for the Big Day was terrible: clouds and rain, so I remained with my friends in Sussex, in the southeast. The eclipse there would not be total; about 99 % of the solar disc would be covered, but the weather was forecast to be good.

As the Moon covered the Sun, the light grew less, but it did not redden, as it does in the evening when the Sun sets. Nothing looked as though it was changing, but my eyes' ability to discern detail vanished. Then, when all we could see of the Sun was a threadlike sliver, gaps between the leaves in trees behaved like countless pinhole cameras, making the trees look sparkly, with their leaves decorated with little crescents. I will never forget the experience. Every eclipse experience is different, so it pays to catch one or two, or more.

Jupiter shines brightly, low in the southwest after sunset, and Saturn low in the south. Venus rises before dawn, shining more brilliantly than Jupiter. The Moon will be Full on 7 August.

**Ken Tapping is an astronomer with the NRC's Dominion Radio Astrophysical Observatory, Penticton, BC, V2A 6J9.**

**Tel (250) 497-2300, Fax (250) 497-2355**

**E-mail: [ken.tapping@nrc-cnrc.gc.ca](mailto:ken.tapping@nrc-cnrc.gc.ca)**