

PARTIAL LUNAR ECLIPSE

By: Team ASO*

In the early morning of this Friday, November 19, 2021 (night of the 18), a partial lunar eclipse can be observed, which will be visible from West Africa, Western Europe, North America, South America, Asia, Australia, Ocean Atlantic, and Pacific Ocean.

VISIBILITY FROM OUR COUNTRY

As long as we have a clear sky at dawn on Friday 19, we will be able to observe the lunar eclipse in Bolivia as follows:

From **illustration 1** and the data in the table shown below, we can observe that the Moon, in its orbital movement from West to East, enters the area of Earth's **penumbra**(P1) at 02:00, Bolivian time. However, while the Moon is in semidarkness, no change in brightness can be seen with the naked eye.

The first contact with the **umbra** (U1) occurs at 03:18. From this moment on, it will be appreciated how the lunar disk enters the Earth's shadow cone, thus being obscured by it.

At the peak of the eclipse, at 05:03, the Moon will be 97% within the **umbra**.

At 06:47, the Moon leaves the umbra completely (U4). Finally, it leaves the penumbra at 08:05 (P4), Bolivian time.

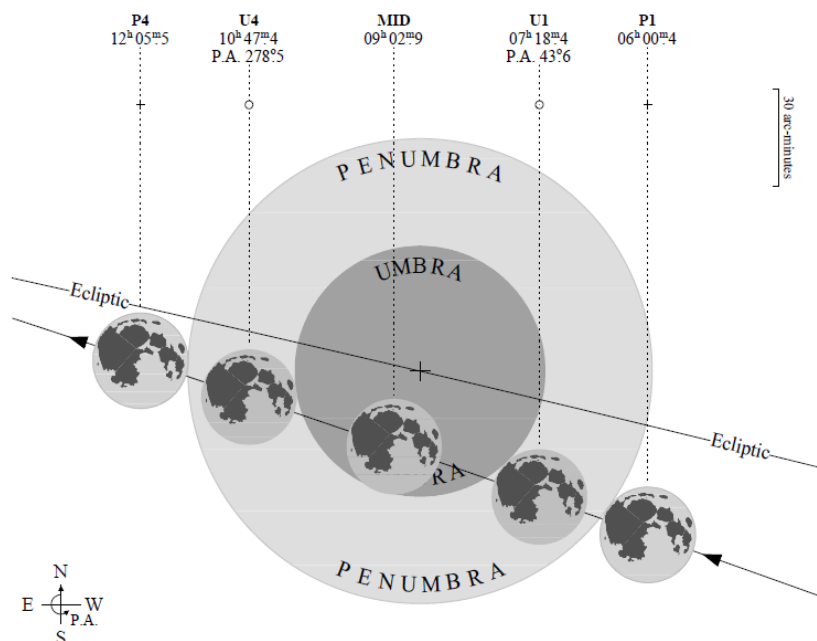


Illustration 1: Graph obtained from "Astronomical Phenomena for the year 2021", published by the USNO-HMNAO (The hours are in universal time - UT. To transform them to Bolivian time, you have to subtract 4 hours). The arrows show the direction of the Moon's orbital motion as we see it from our observation point.

The table below shows, besides the hours, the **height at which the Moon will be above the horizon** in the aforementioned events, for the main cities of Bolivia.

Thus, for example, for Cochabamba, you can see that, at the maximum of the eclipse, the Moon will be at a height of 9 degrees, so the observation of this phase may become difficult to observe from the city due to the mountains that surround it.

Similarly, you can notice that the Moon will be at a height of 14 degrees below the horizon when the shadow phase (umbra) ends, therefore, this phase will no longer be visible.

VISIBILITY TABLE FOR THE MAIN CITIES OF BOLIVIA
(Bolivian time) For the early morning of Friday, November 19, 2021 (night of the 18)

City	Beginning of the Penumbral Phase P1	Moon height (degrees)	Contact U1 Entrance to the Umbra	Moon height (degrees)	Eclipse Peak	Moon height (degrees)	Contact U4 Exit from the umbra	Moon height (degrees)	End of the penumbral phase P4
<i>Cochabamba</i>	02:00	43	03:18	30	05:03	9	06:47	-14	08:05
<i>La Paz</i>	02:00	45	03:18	32	05:03	11	06:47	-12	08:05
<i>Oruro</i>	02:00	44	03:18	30	05:03	9	06:47	-13	08:05
<i>Potosí</i>	02:00	42	03:18	28	05:03	7	06:47	-15	08:05
<i>Cobija</i>	02:00	50	03:18	36	05:03	13	06:47	-10	08:05
<i>Sucre</i>	02:00	42	03:18	28	05:03	7	06:47	-15	08:05
<i>Tarija</i>	02:00	39	03:18	26	05:03	6	06:47	-17	08:05
<i>Santa Cruz</i>	02:00	41	03:18	27	05:03	6	06:47	-17	08:05
<i>Trinidad</i>	02:00	45	03:18	30	05:03	8	06:47	-15	08:05

*Height data with a negative sign indicate that the Moon is those degrees below the horizon.

It is expected that, while the Moon is within the umbra, it acquires a reddish hue, which is not due to any supernatural phenomenon but to the conditions of our atmosphere at the time of the eclipse.

The eclipse can be observed with the naked eye or with instruments.

¿WHAT IS A LUNAR ECLIPSE?

A lunar eclipse occurs when the moon passes through the Earth's shadow on its way around it; and it is visible in all places on our planet, where, at the time it occurs, it is night and the Moon is above the horizon.

The shadow is made up of the **Cone of Penumbra** and the **Cone of Shadow** or **Umbra**. The Cone of Penumbra is not as dark as the Cone of Shadow (**Illustration 2**), in fact, when the Moon enters the penumbra, no decrease in brightness intensity is visible to the naked eye; Instead, when it begins to enter the Cone of Shadow, you can clearly appreciate how darkness begins to cover its shiny surface.

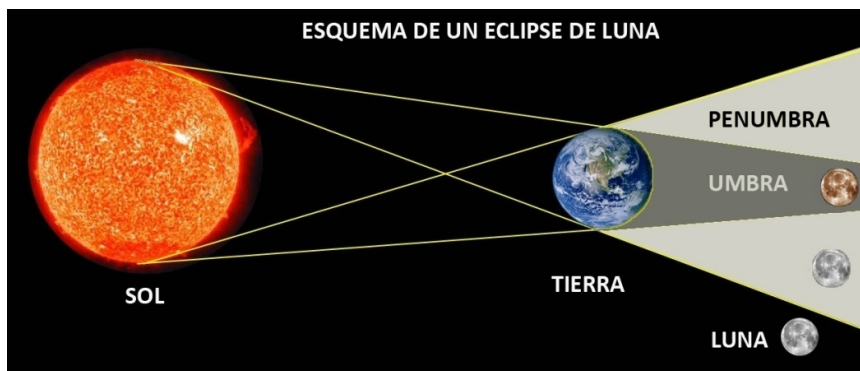


Illustration 2: Explanatory graphic of a lunar eclipse; The sizes and distances are arbitrary, for educational purposes.

A **TOTAL** lunar eclipse happens when the Earth's shadow covers 100% of the lunar disk.

In the case of the eclipse of November 19, it is a **PARTIAL ECLIPSE**, since at the maximum moment of the eclipse, the earth's shadow will cover only 97% of the lunar disk.

THE FASCINATION OF OBSERVING A LUNAR ECLIPSE

The systematic observation of the Moon dates back to the Palaeolithic Period according to archaeological remains found in caves in France and Germany. Druid astronomers of those times have been shown to have developed lunar calendars, as part of the need to understand the annual cycles of the Moon and seasonal changes.

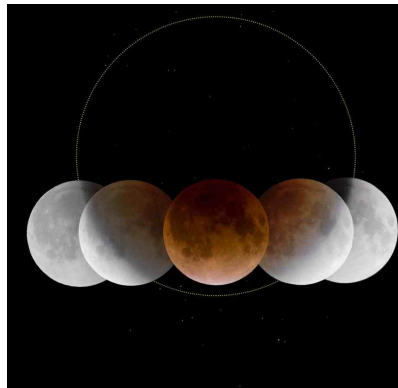
The oldest record of a lunar eclipse is from the year 776 BC, in which this phenomenon is described through the verses of a poem from the Shijing, a classic of Chinese poetry. In fact, it was the ancient Chinese astronomers who made the oldest records of this phenomenon.

The observation of the shadow of the Earth in the lunar disk, during an eclipse, has led the attentive eye of ancient and modern observers to deduce and verify the sphericity¹ of our planet, as we can see in the two images below:

¹Actually, the shape of the Earth is a geoid, however for practical purposes it can be assumed to be a sphere.



(Above) The shadow of the Earth is projected showing its curvature (photo published in: www.descubriolahistoria.es)



(Left) In this composition of photographs during a lunar eclipse, the spherical shape of the Earth can be clearly seen, as it casts its shadow on the lunar disk, at different times during the eclipse. The shadow is marked for educational purposes.

(Image published in: www.meganoticias.cl)

Although lunar eclipses in ancient times were almost always associated with discouraging historical events or bad omens, today they are a spectacle that brings us closer to the contemplation of the sky, and feeling ourselves, for a few moments, part of the Universe, from which we come.

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