

A Jewish Festival of Eclipses

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A sequence of four consecutive total lunar eclipses coincides with Passover and Succoth in 2014 and 2015. All or parts of these four eclipses will be visible over Florida. Religious fanatics may herald this series of eclipses with dire pronouncements. This is biblical nonsense and contrary to modern scientific learning. Instead, these events give us multiple opportunities to experience one of nature's wonderful spectacles

Some Jewish peoples may remember the Passover holiday of 1996 April 3. Still, a passage of eighteen years might make this difficult. After all, are not most Passovers alike? Or not? For example, on this spring evening Rabbi Allan Lehman of Congregation B'nai Israel in Gainesville, Florida interrupted his Seder. Family and guests took a short stroll to the back field of the synagogue to watch the Passover full moon rise above the eastern horizon. Instead of an expected large, brilliant moon, a spectacular ruddy and noticeably dimmer orb shone above distant trees. Although the Jewish calendar sets Passover to occur near times of full moons, this full moon was in the middle of a total eclipse! (A lunar eclipse occurs when the Moon passes partially or fully into Earth's shadow.)



A Total Lunar Eclipse
(2010 December 21)

Now, nearly a score of years later, a total lunar eclipse will again occur for Florida on Erev Pesach, April 14. (*Erev* means the evening on which a Jewish holiday begins since Jewish days begin at sunset.) This time no interruption of the ritual feast will be necessary for the eclipse begins after most Seders will have concluded.

However, this eclipse of the Moon is different from some others for it begins a sequence of four total lunar eclipses. And each coincidentally coincides or nearly coincides with Jewish festivals.

The Tetrad and a Plethora of Total Lunar Eclipses

The upcoming spring eclipse begins shortly after midnight on April 15 (coincidentally a “tax day eclipse”). More important, this eclipse begins an interesting sequence of four consecutive total lunar eclipses, two in each of 2014 and 2015. The consecutive nature of these **four total lunar eclipses** is a series known as a **tetrad**. *In addition, these four eclipses occur near the beginnings of either Passover and Succoth.*

The four consecutive total lunar eclipses in a tetrad occur at intervals of 177 days or six lunations (the time between successive new moons). Nevertheless, tetrads themselves can be either common or infrequent. For instance, *none happened* for more than three centuries, in the years 1582 to 1908. But, sixteen tetrads occur from 1909 to 2156 with *eight in the 21st century!* (The eight total lunar eclipse tetrads from 2001 to 2100 fall in the years 2003/04, 2014/15, 2032/33, 2043/44, 2050/51, 2061/62, 2072/73 and 2090/91).

Thus, the frequency of tetrads is very variable. In fact, groups of tetrads repeat with a frequency of nearly six centuries (586 years). For about 300 years no tetrads will occur. Then over the next 300 years or so about fifteen to nineteen tetrads follow. So, we are now living in a period where tetrads are taking place!

The last tetrad was ten years ago, 2003-04, with three of the four total lunar eclipses visible in Florida. The next tetrad is now imminent, 2014-15. So, weather permitting, Floridians will see all or part of the four upcoming total lunar eclipses during the 2014-15 tetrad!

This is likely the last tetrad that some of us will experience since the next tetrad is not until 2032-33. Moreover, neither of the first two 2032-33 tetrad eclipses coincide with Jewish holidays nor are they visible from Florida. The remaining two eclipses in the 2032-33 tetrad will indeed occur on Passover and Succoth. Nevertheless, the former is not visible in Florida and only the first half of the latter will be visible before the moon sets. In addition, no other tetrad in the 21st century coincides with Jewish festivals.

Passover, Succoth and the 2014–15 Tetrad

Every year brings at least two lunar and two solar eclipses. (The greatest number is seven in various combinations.) The years 2014 and 2015 are no exception and include the four tetrad total lunar eclipses plus four additional solar eclipses.

Table 1 lists the four total lunar eclipses (**TLE**) of this lunar tetrad showing their coincidence or near coincidence with the two important Jewish festivals of Passover and Succoth. This table also gives dates and times for beginning partial phases, maximum eclipse and ending partial phases. *Fortunately, all or parts of these four eclipses are visible from Florida.* Note that local times of eclipses depend on your time zone and some eclipses may occur just before the festival begins. (The 2014 October 8 eclipse, for example, ends in morning but Succoth begins that night.)

Furthermore, this period also has four solar eclipses, one partly visible in Florida and one nearly coincident with Rosh Hashana in Florida (and not visible in the Sunshine State). A *partial solar eclipse (PSE)* falls on 2014 October 23 but does not coincide with any Jewish festival. Only the first part of the 2014 October eclipse is visible in Florida since the Sun sets about an hour or less after the eclipse starts (**Table 1**).

Yet, another *partial solar eclipse* does, in fact, falls nearly on a Jewish holiday, Rosh Hashana, 2015 September 13. Unfortunately this solar eclipse is only visible over parts of Antarctica and southern Africa (**Table 1**)! Also, the eclipse actually ends before Erev Rosh Hashanah begins in Florida that evening.

Table 1. Eclipses Visible in Florida or Coincident with Jewish Holidays in 2014–15

Eclipse Date	Jewish Date	Jewish Festival	Type Eclipse	Visibility from North Florida (All Times Eastern Daylight Time)
2014 Apr 15	Nisan 15	Passover	TLE	Begins after midnight; entire eclipse visible Begins 1:58 a.m., Mid-Eclipse 3:46 a.m., Ends 4:33 a.m.
2014 Oct 8	Tishri 15	Sukkoth	TLE	Totality ends just before sunrise; Sukkoth begins in evening Begins 5:15 a.m., Mid-Eclipse 6:55 a.m., Ends 8:34 a.m.
2014 Oct 23	Tishri 29	None	PSE	Partial <i>solar eclipse</i> ends after sunset Begins 5:13 p.m., Sunset 5:51 p.m. (Times for Gainesville)
2015 Apr 4	Nisan 15	Passover	TLE	Only beginning of partial eclipse visible Begins 6:16 a.m., Mid-Eclipse 8:00 a.m., Ends 9:45 a.m.
2015 Sep 13	Tishri 01	Rosh Hashanah	PSE	Partial <i>solar eclipse</i> . Ends before Erev Rosh Hash. in Fla. Not visible from USA (only Antarctica and southern Africa)
2015 Sep 27	Tishri 15	Sukkoth	TLE	Entire eclipse visible starting early evening; ends next day Begins 9:07 p.m., Mid-Eclipse 10:47 p.m., Ends 12:27 a.m.

Religious Nonsense

Religious fanatics may hype these events due to synchronism with Jewish Holidays. However, eclipses must occasionally fall on or near some Jewish holidays. The lunar cycle averages about 29-1/2 days and the Jewish calendar is a lunar-solar calendar with 29 or 30-day lunar months.

Therefore, holidays that fall on the first or fifteenth day of a Jewish month will always fall on or near new or full moons respectively. These are also times when solar or lunar eclipses are each possible. Thus, both Passover and Sukkoth, which occur on the 15th day of their respective lunar months, must fall near dates of full moons and potentially lunar eclipses. And Tishri 1 (Rosh Hashanah), a new moon date, nearly coincides with the 2015 September solar eclipse.

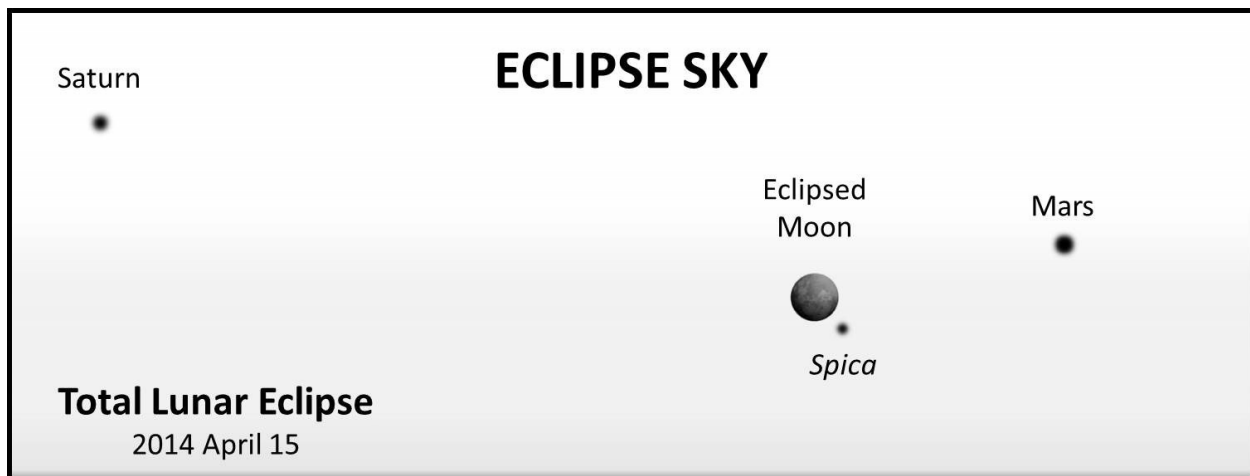
Moreover, six lunar months of 29 and 30 days (177 days or six lunations) typically separate Passover and Sukkoth. This period is similar to the separations of successive lunar (or solar) eclipses. Therefore, if an eclipse occurs on Passover, an eclipse on Sukkoth is sometimes possible. So, the “chance occurrence of eclipses” on Jewish festivals is less remarkable than it would first seem.

Finally, studies of eclipse frequencies show the first eclipse in a tetrad always falls between mid-February and mid-June, an interval that includes the beginning date of Passover. So, eventually some tetrads will have all lunar eclipses coincide with these religious holidays as it happens in 2014-15, on the holidays of Passover and Sukkoth (full moon holidays).

Red Blood Moons

Zealots may also emphasize these tetrad eclipses as “red blood moon” occurrences. Yet this is normal for most lunar eclipses. Residual sunshine bent into Earth’s shadow by its atmosphere can illuminate an eclipsed moon with varying amounts of subdued light. Since Earth’s atmosphere scatters blue light more efficiently than red, this subdued light can color the Moon with various shades of orange or reddish colors. So, no two lunar eclipses appear quite the same. Consequently, not only total lunar eclipses of the present tetrad but also all total lunar eclipses can sometimes take on colorful, beautiful hues.

If the 2014 April 15 eclipse is typical, the fully eclipsed Moon should display a beautiful other color. In addition one of the sky’s brighter stars (*Spica* in Virgo) will appear just below and to the right of the eclipsed Moon. Saturn will also shine to the left and brilliant, orangy Mars to the right of a possible ruddy Moon. (See diagram below.)



Regrettably, natural occurring phenomena as this only helps religious fanatics who are now trying to hype this tetrad with ominous predictions; they will even “cherry-pick” past historical events that may have occurred during (or near) previous tetrads. The use of phrases like “red blood moons” also contributes to these unnecessary omens.

Unfortunately, understanding of our natural world still remains fixed in the thinking of our ancient past. Thus, too many people still believe either in superstitious nonsense, retain beliefs long abandoned by the scientific community or lack fundamental knowledge about our physical and biological world. For example, the National Science Foundation surveyed more than 2,200 people in the United States in 2012. The study, recently released (2014 February) showed *26 percent of Americans still do not know that the Earth orbits the Sun.* So, is it not surprising that every time some interesting astronomical event occurs, doomsayers come out of the wall? Enjoy this tetrad for what it is—an interesting cycle of total lunar eclipses and nothing more.

If you remain awake this coming Passover, as did the five rabbis at the Bnei Barak all-night Seder centuries ago, take this opportunity to go outside and see a beautiful thing! ✨

(More information about the dates and times of the four tetrad eclipses for Florida is at <http://tiny.cc/ljascx>.)