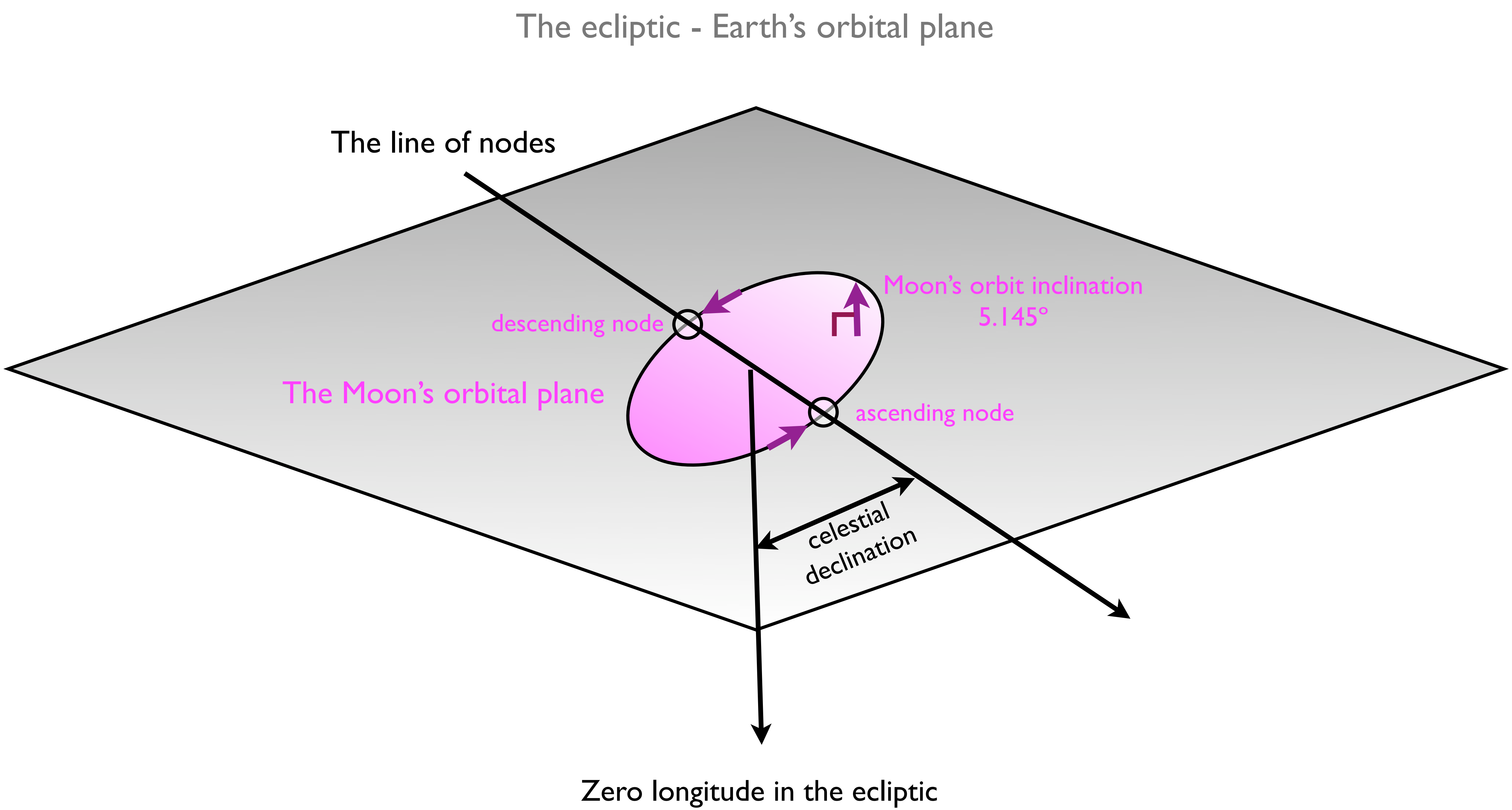
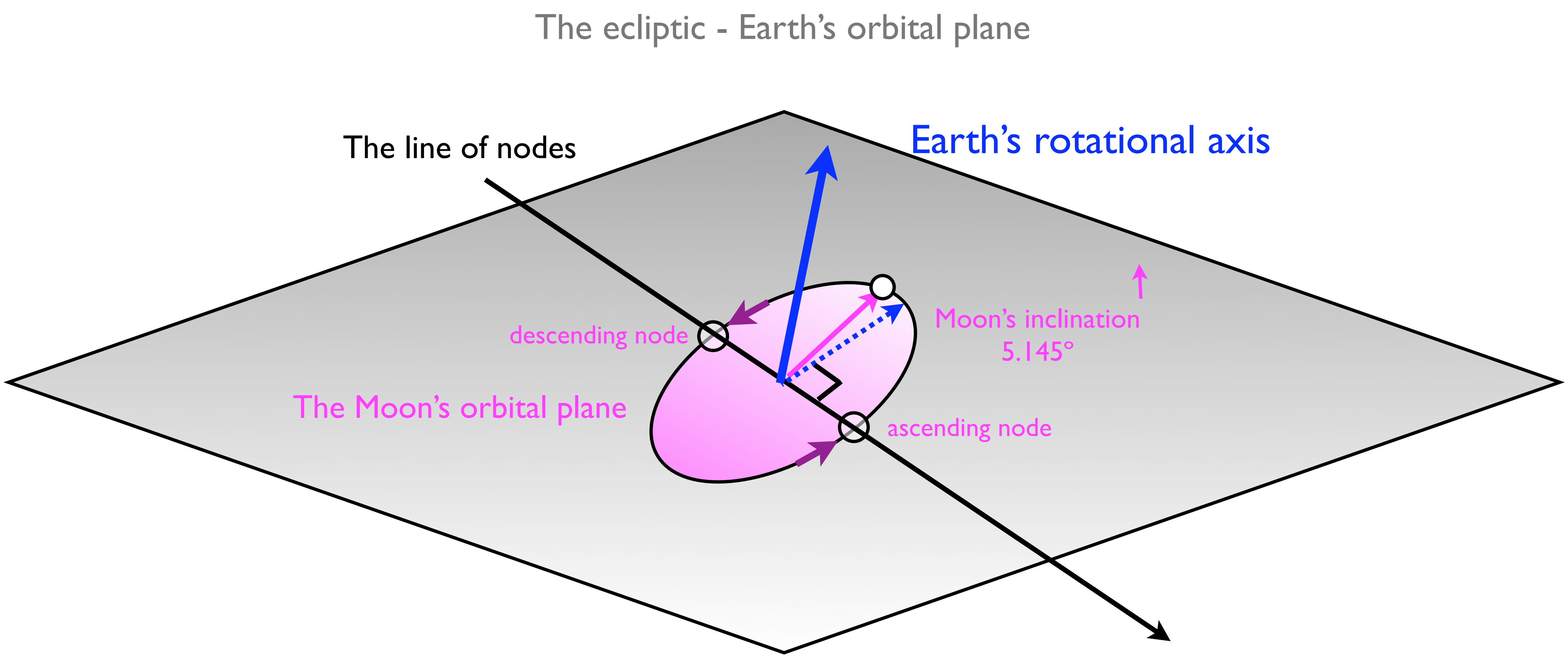
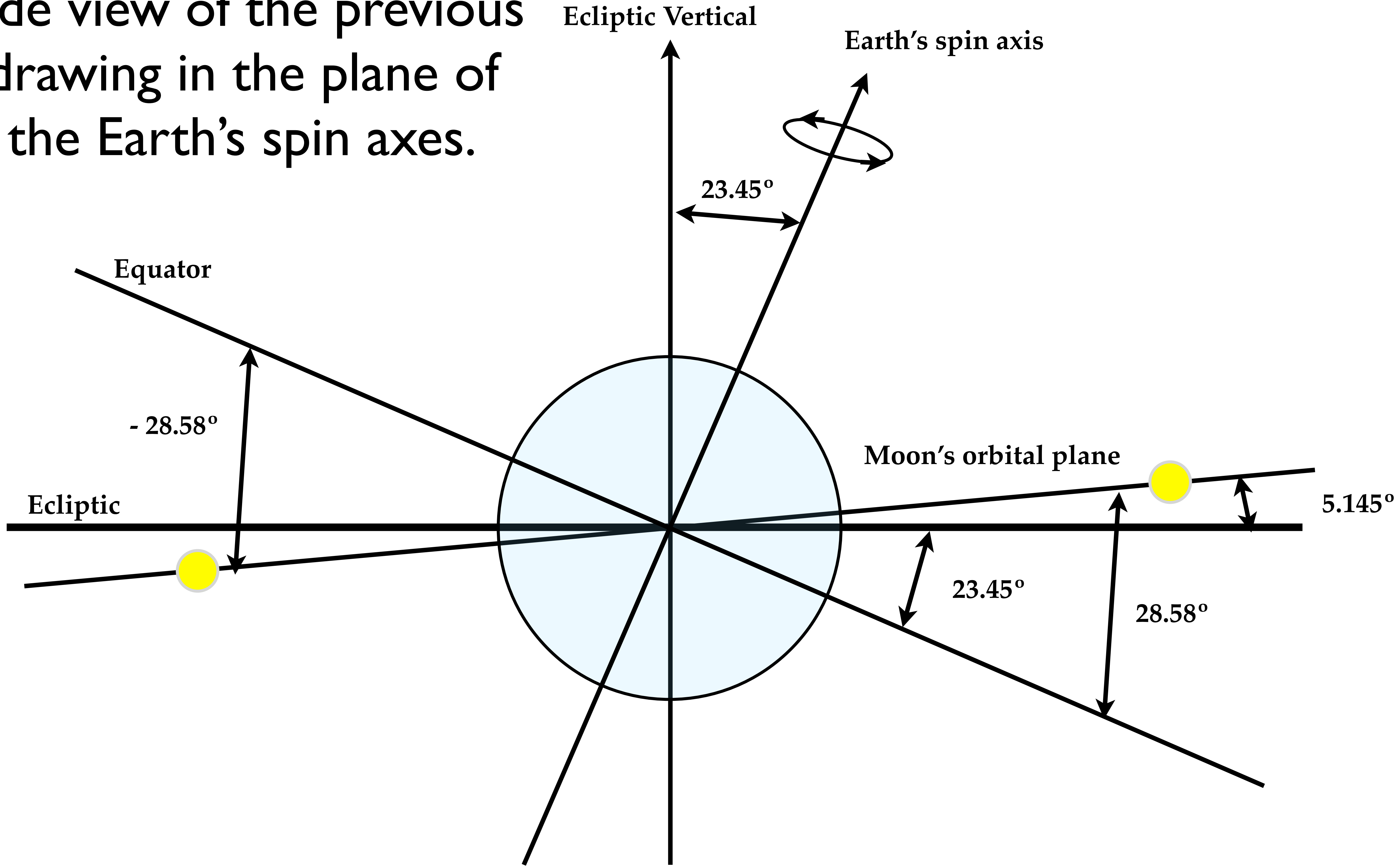


The orbit of the Moon is inclined at an angle of 5.145° to the ecliptic. The Moon has two nodes: the ascending node is where the Moon passes upward through the ecliptic, and the descending node is where it passes downward. The line of nodes is the line in the ecliptic that passes through the nodes. The angle between the zero longitude in the ecliptic and the line of nodes is the celestial declination of the Moon's nodes. Owing to gravitational perturbations this angle makes a complete rotation in the ecliptic plane in 18.6 years.



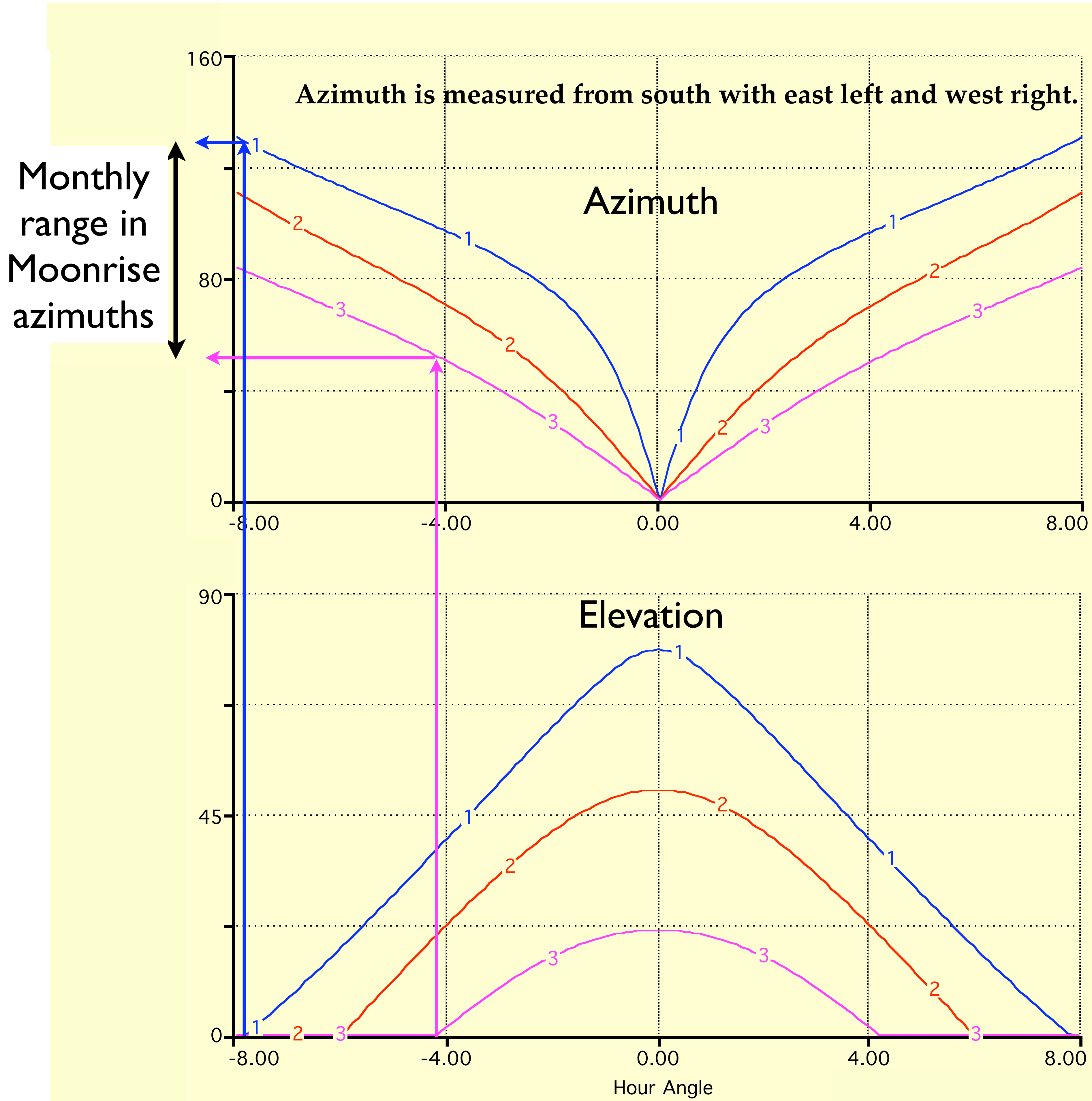
For practical purposes the Earth's rotational axis is fixed in the celestial sphere and directed at 23.45° to the vertical. When the line of nodes is perpendicular to the projection on the Earth's axis onto the ecliptic and the Moon is above the ecliptic, the angle between the Earth's axis and the Moon is at its minimum. At this time the Earth's equatorial plane is tilted 23.45° below the ecliptic; thus, the moon is at its maximum angular position above the horizon (23.45 + 5.145 = 28.595) in the northern hemisphere.

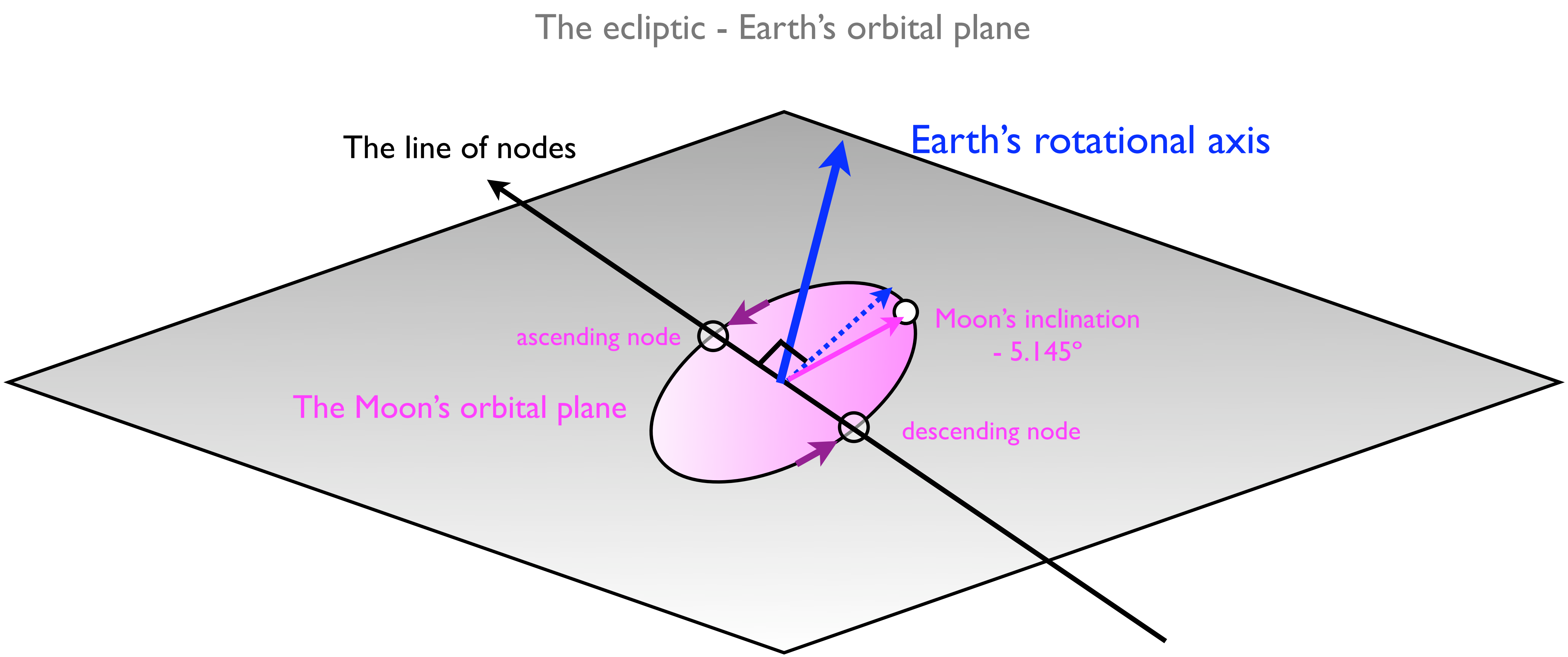
Side view of the previous drawing in the plane of the Earth's spin axes.



In one half of a sidereal month (27.32/2 = 13.66 days) The Moon moves from the indicated position on the right to the position on the left. The declination changes from 28.58° to - 28.58. (Owing to rounding of values before and/or after sums there is a small discrepancy in the values.)

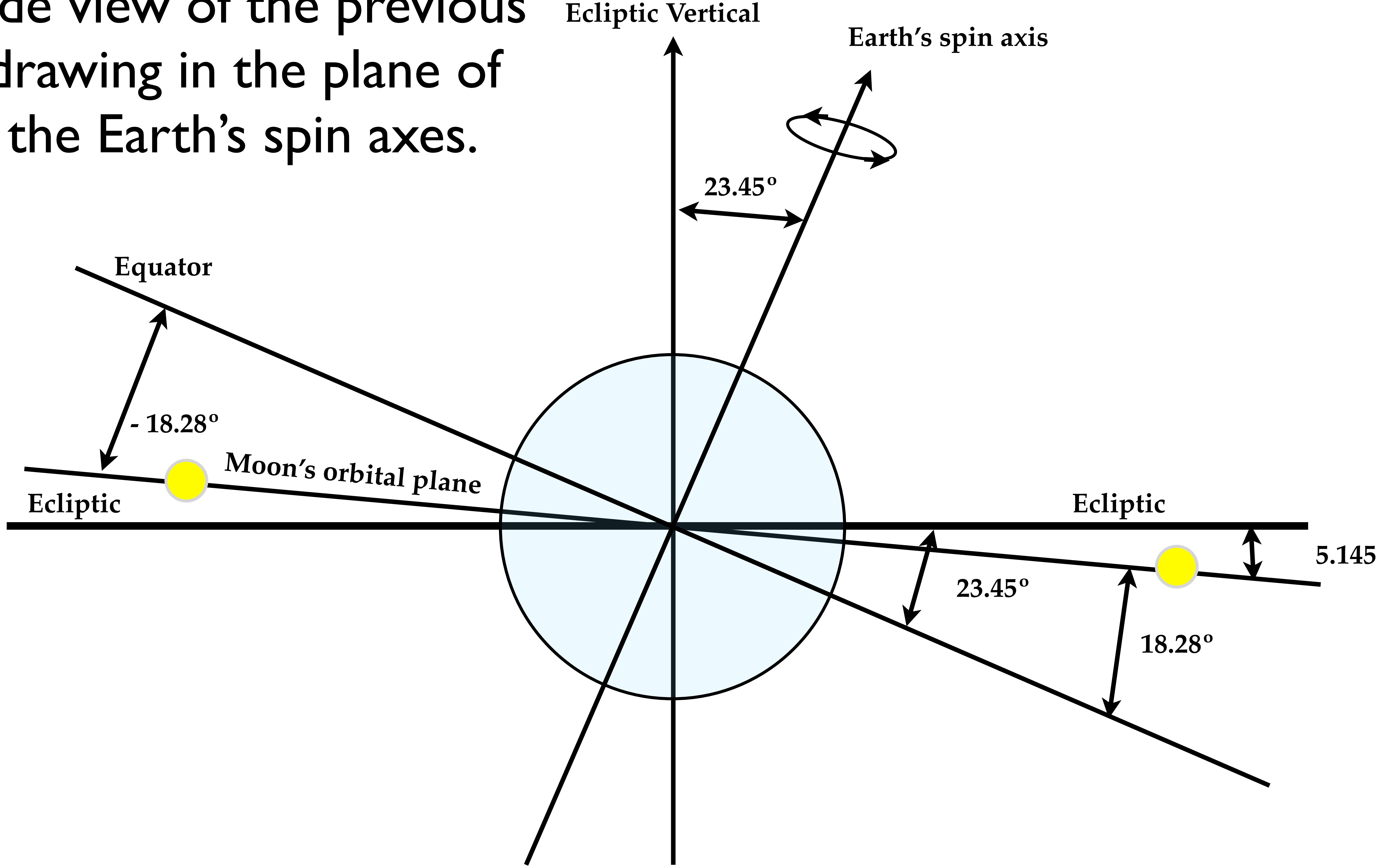
Moon's locations at maximum = major standstill





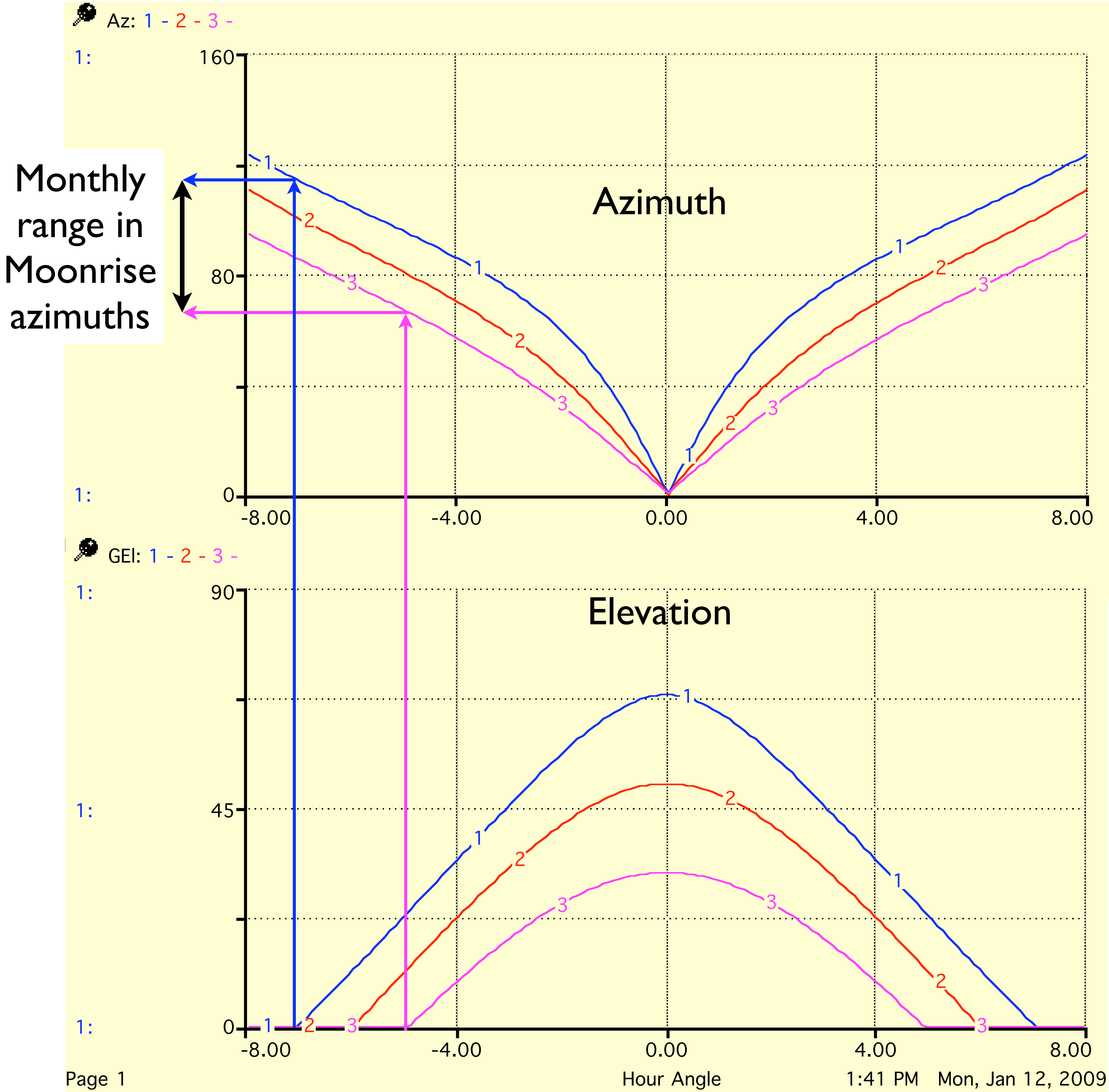
9.3 years later the line of nodes has rotated 180° and is once again perpendicular to the projection of the Earth's axis onto the ecliptic, but this time the Moon is below the ecliptic, and the angle between the Earth's axis and the Moon is at its maximum. At this time the Earth's equatorial plane is tilted 23.45° below the ecliptic; thus, the moon is at its minimum angular position (23.45 - 5.145 = 18.305) above the horizon in the northern hemisphere.

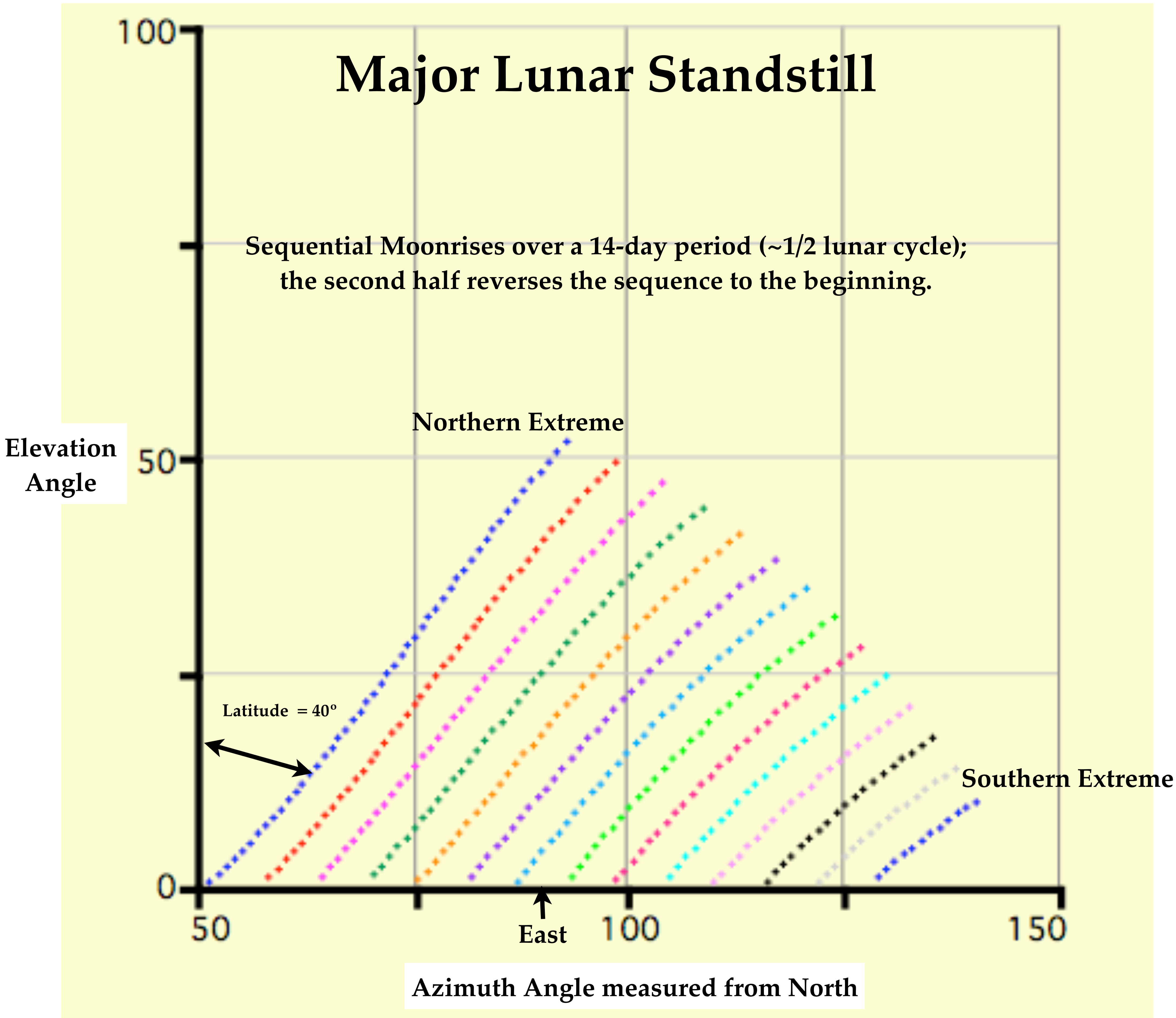
Side view of the previous drawing in the plane of the Earth's spin axes.



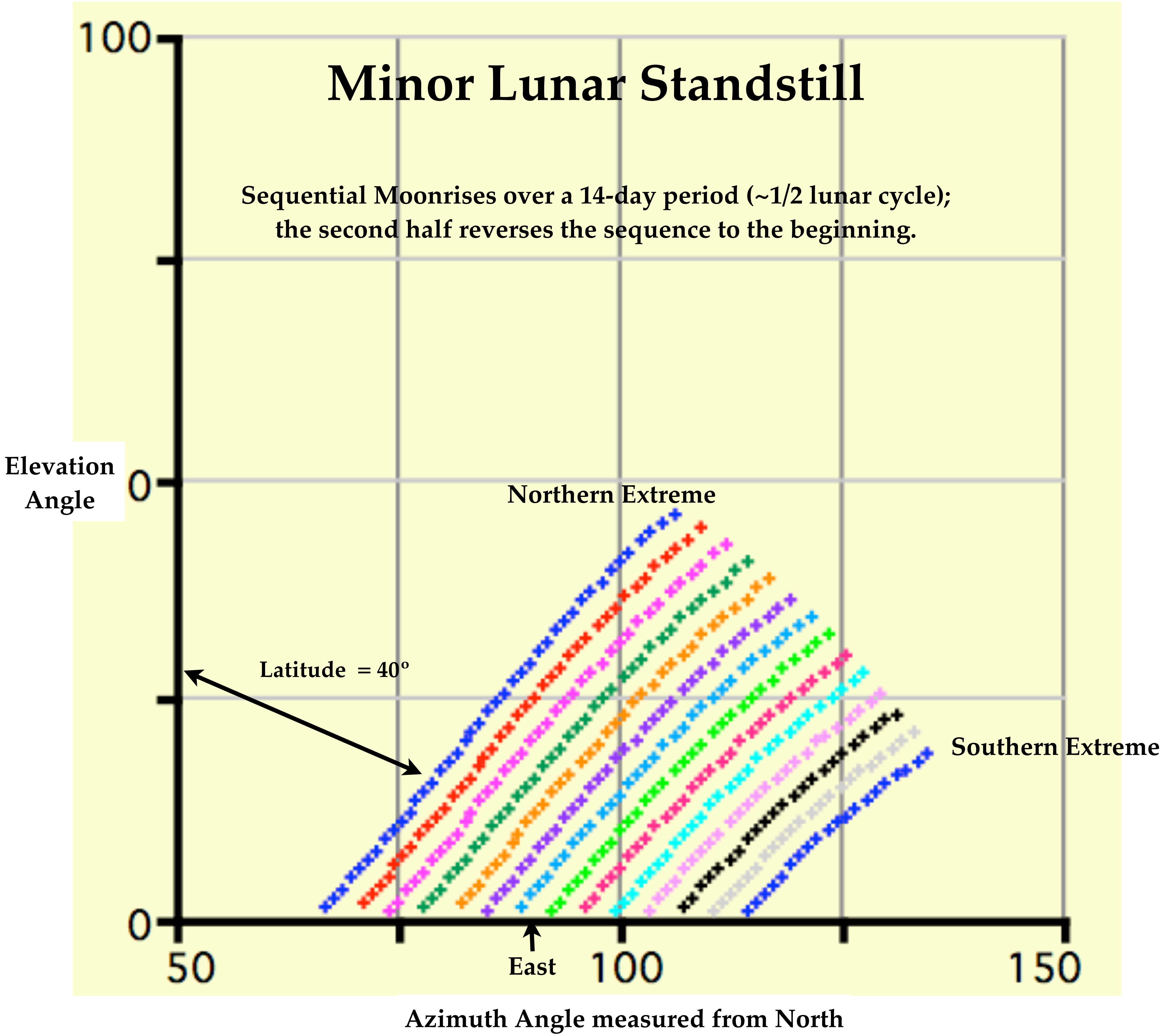
In one half of a sidereal month (27.32/2 = 13.66 days) The Moon moves from the indicated position on the right to the position on the left. The declination changes from 18.28º to - 18.28º. (Owing to rounding of values before and/or after sums there is a small discrepancy in the values.)

Moon's locations at minimum = minor standstill.



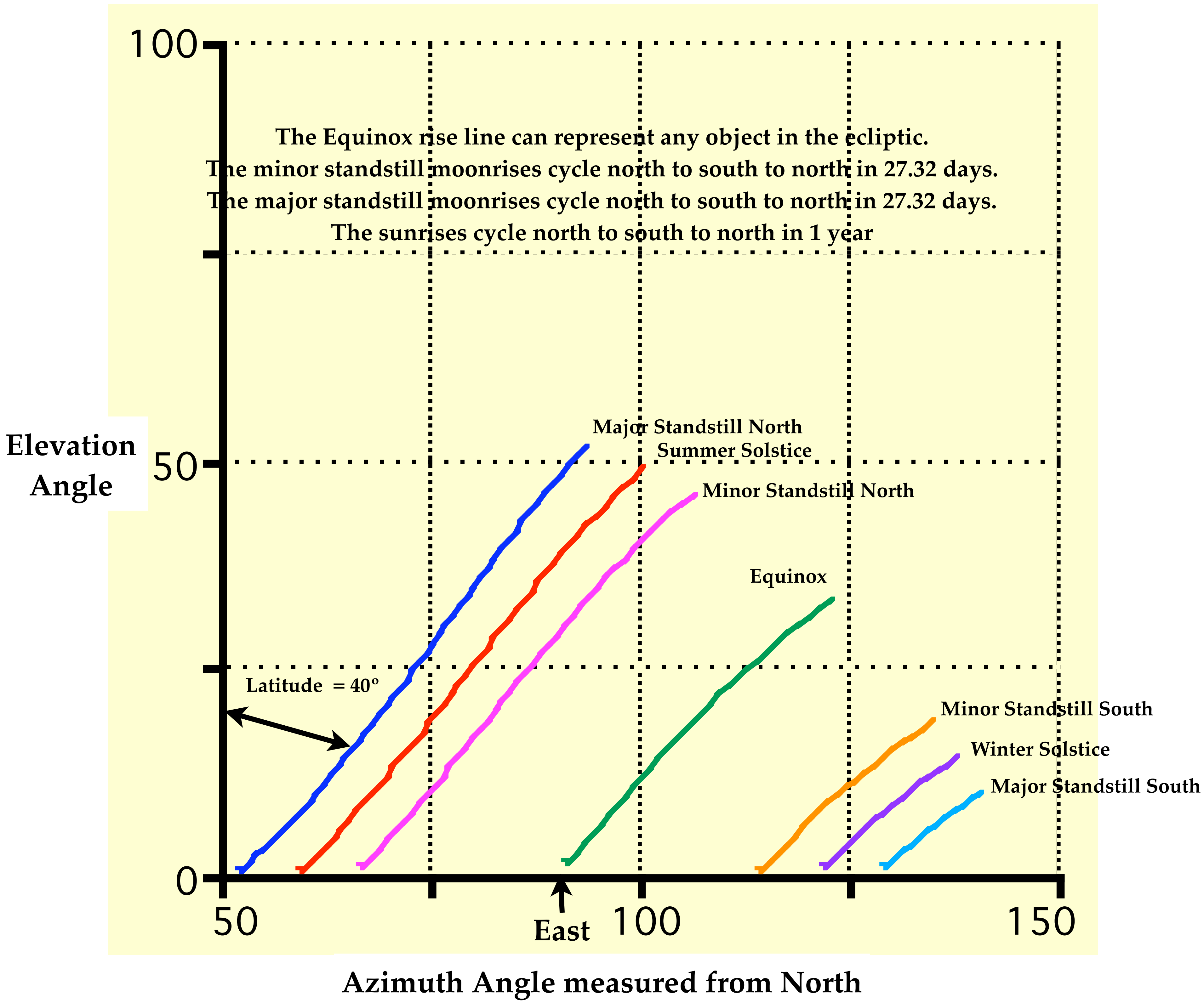


Major Lunar Standstill
Sequential Moonrises over a 14-day period (~1/2 lunar cycle);
the second half reverses the sequence to the beginning.
Northern Extreme
Southern Extreme
Latitude = 40°
Elevation Angle
100
50
0
50
100
150
East
Azimuth Angle measured from North



Minor Lunar Standstill
Sequential Moonrises over a 14-day period (~1/2 lunar cycle);
the second half reverses the sequence to the beginning.
100
0
0
Elevation
Angle
Northern Extreme
Latitude = 40°
Southern Extreme
50
East
100
150
Azimuth Angle measured from North

Extremes for Sunrises and Moonrises



Since the “standstills” mark the extrema of a cycle lasting 18.6 years the turnaround time at the standstills extends over a long period. The last major standstill was centered on 2006, but in general observations 2005 to 2007 are included. The next major standstill will occur ~2025. The next minor standstill will occur ~2015.

Talk about luck!

The two photos on this slide were overlain using the foreground trees for registration. The Moon in the left photograph is approaching setting and in the right photo the Moon is setting behind Ogalalla Pk. on the horizon. Photos taken with a Konica FT-1 SLR camera with a 500 mm Deitz Reflex lens using Kodak UltraMax film. Digital enhancement was necessary to increase the contrast between the Moon and the sky.

Information on the Photographs

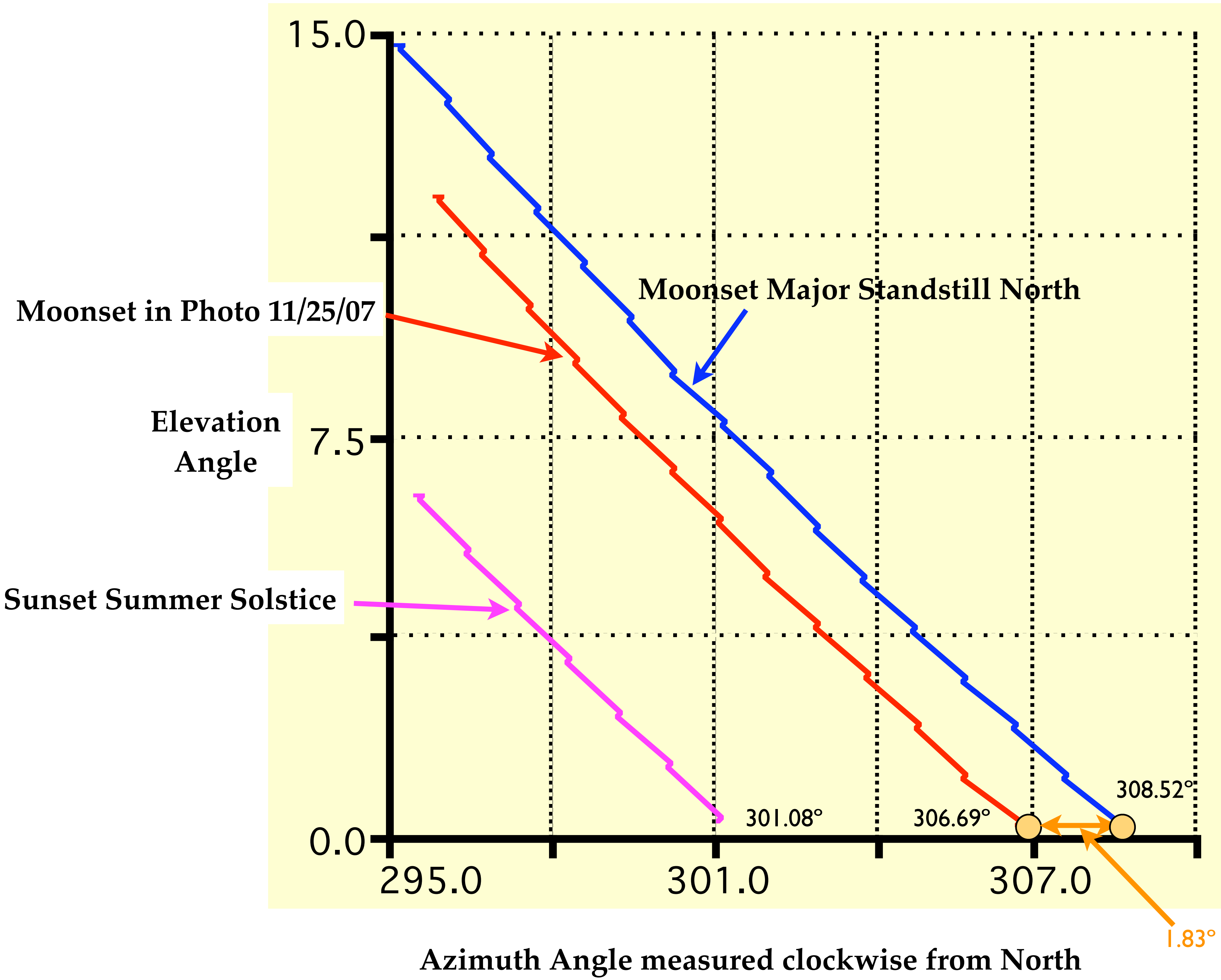
The Moonset photos on the previous slide were not planned in advanced. When taken on November 25, 2007, I had not researched the apparent path of the Moon or its orbital dynamics. I had researched the apparent path of the Sun and marked the positions of the solstices. On the day preceding these photos I had observed that the Moon was setting near or perhaps beyond the summer solstice azimuth. I set up my camera with telephoto lens hoping for a clear morning on the following morning; as seen I was fortunate to have good conditions.

Now over a year later, I have researched the Moon's orbital dynamics and apparent path across the sky. I was indeed lucky because the Moonset I photographed was very near the "major lunar standstill;" I will not see this scene again until ~2025. The web resource referenced below provides the following information: the full Moon occurred the day before my photographs, and the Moon was at its northern limit with a declination of 27.32º. For comparison the maximum declination of the Sun is 23.45º, and the maximum declination for the Moon is 28.58º. These photos are close to the maximum northern limit of the major lunar standstill.

The following slide shows a comparison of the settings of the Sun at summer solstice, the Moon in the photograph, and the Moon at its maximum in the major lunar standstill.

http://www.astro.umass.edu/~young/moontable.html

Northern Extremes for Sunsets and Moonsets



Background in Daylight