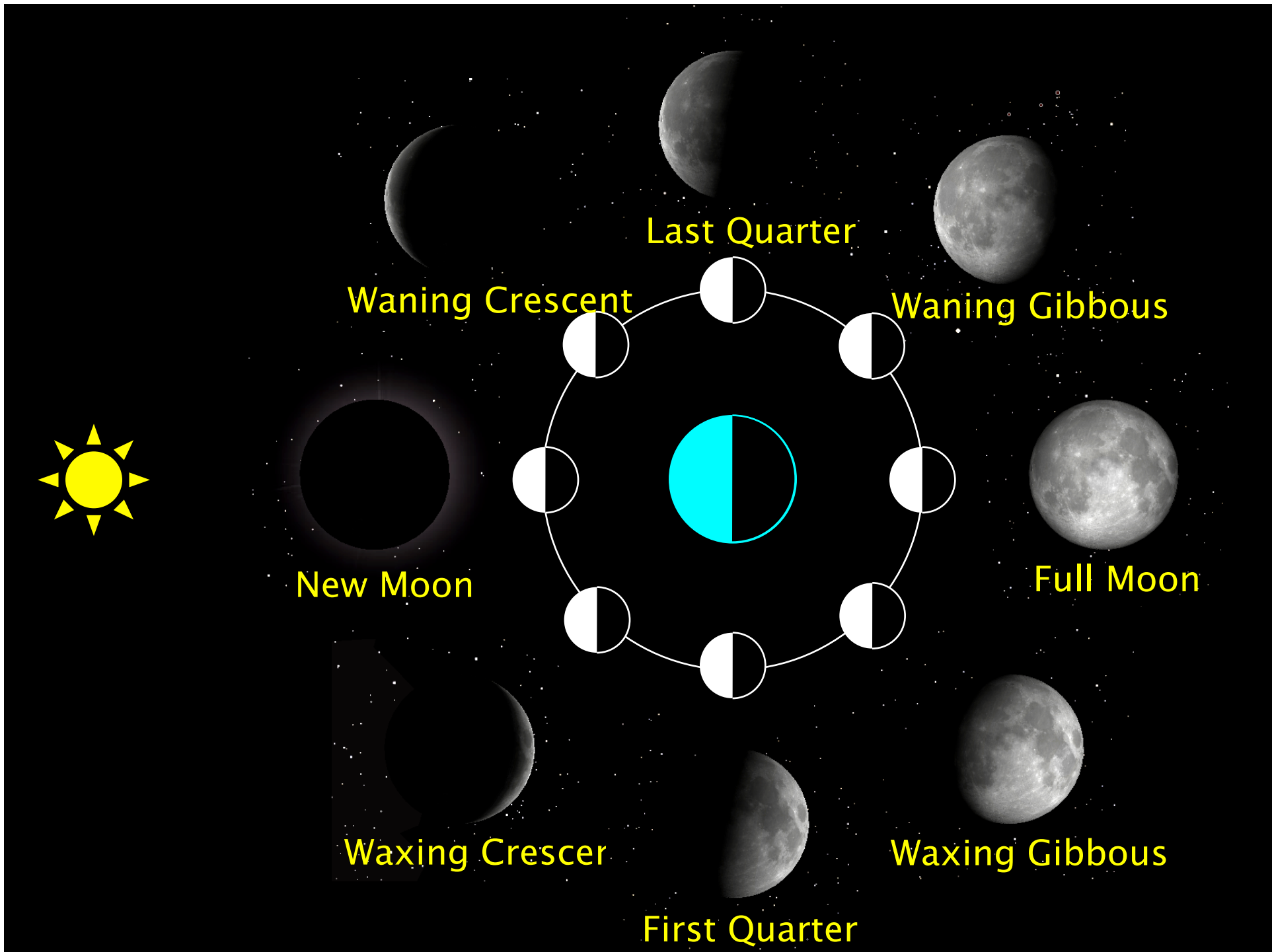
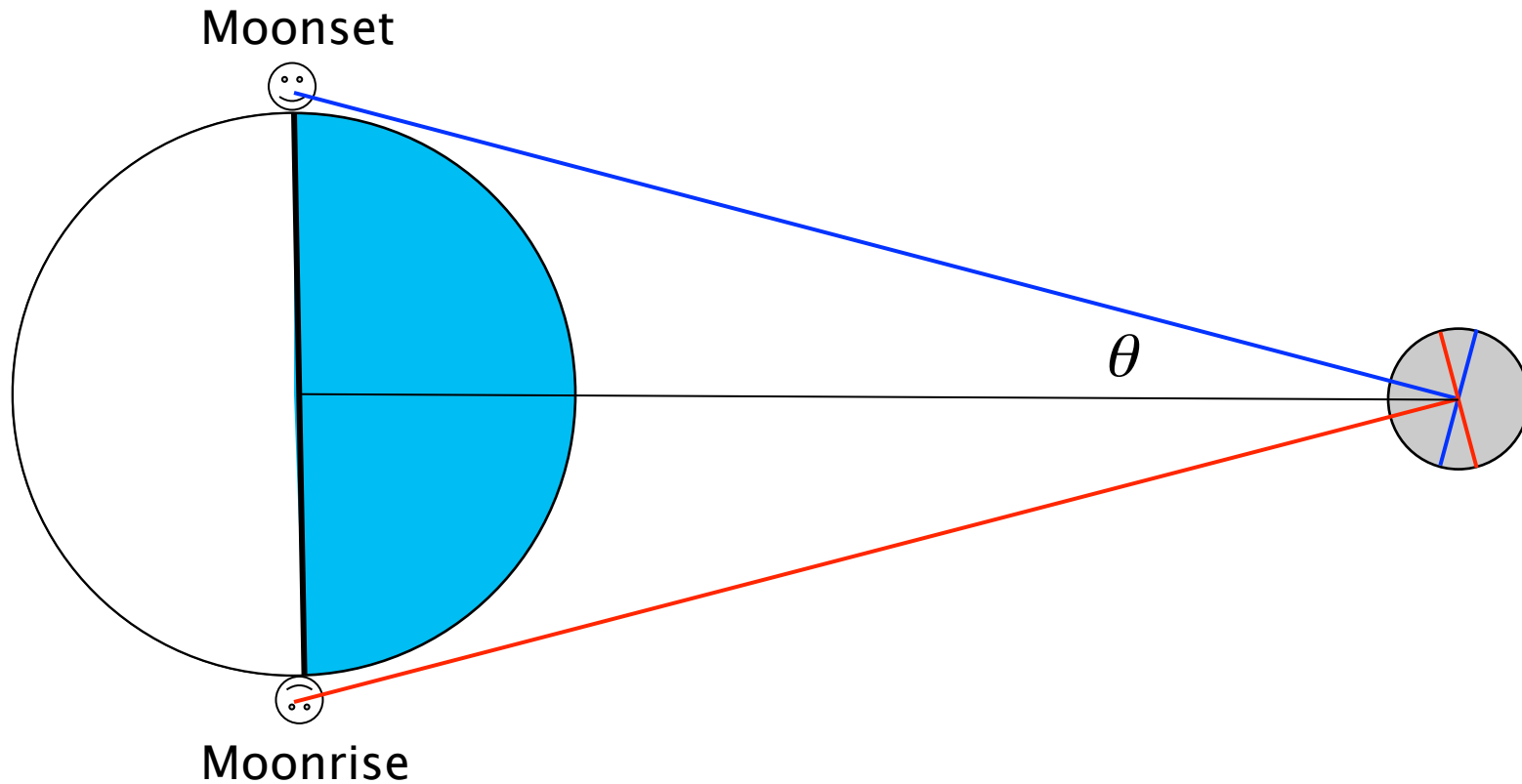


Graphics for Lunar Phenomena

2014 Sept 26



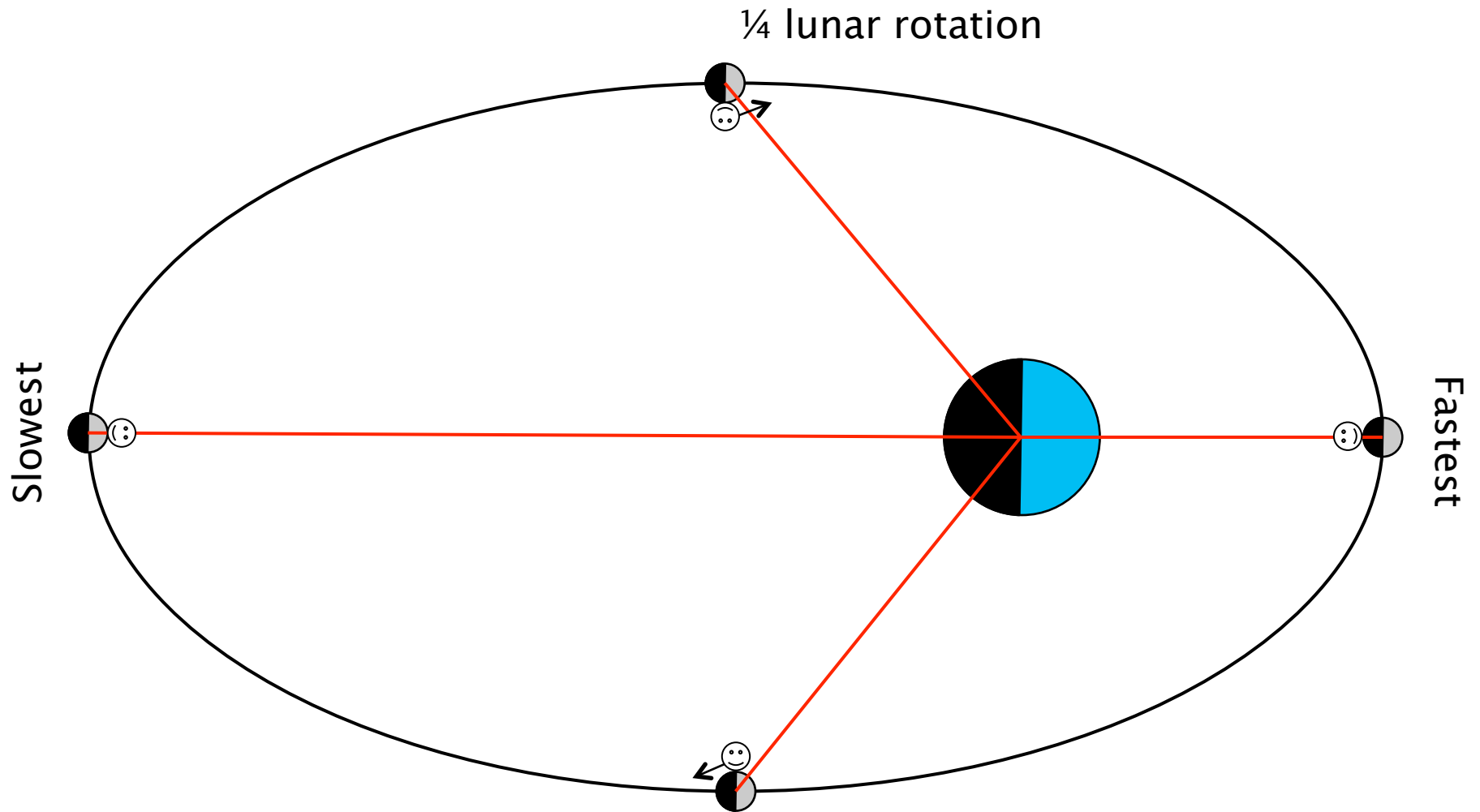
Diurnal Libration



$$d_{\text{moon}} \approx 60 R_E$$

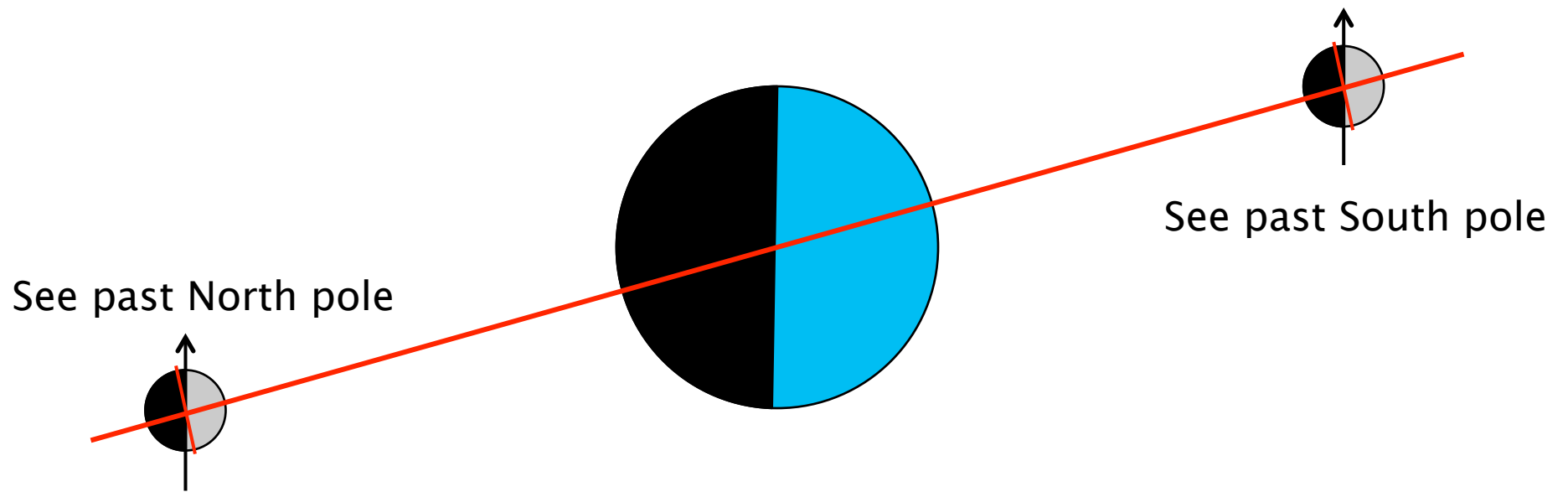
$$\theta \approx R_E / 60 R_E = 1/60 \text{ rad} \approx 1^\circ$$

Libration in Longitude

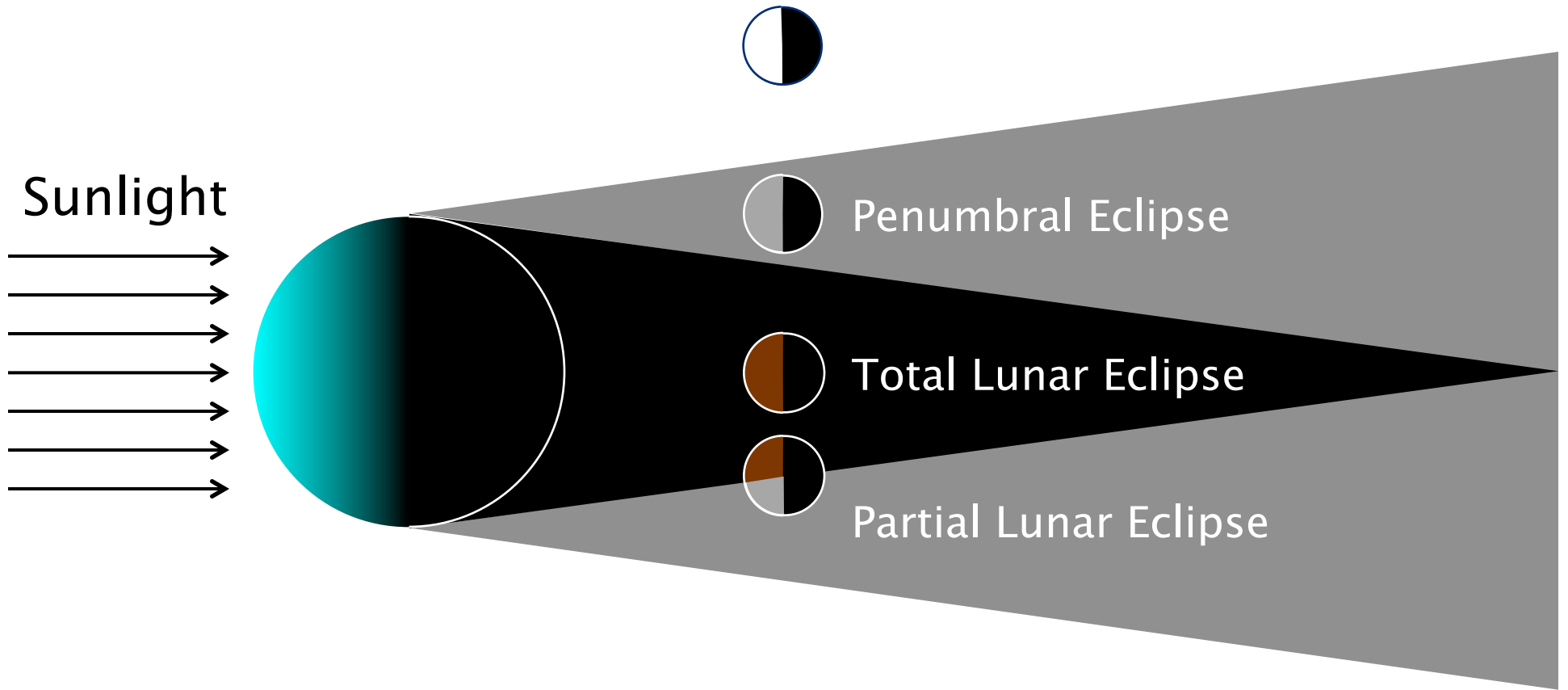


Lunar rotation rate = constant
Orbital speed varies: fastest at perigee, slowest at apogee.

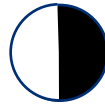
Libration in Latitude



Moon's rotation axis tilted 6.5° relative to its orbital plane



Sunlight



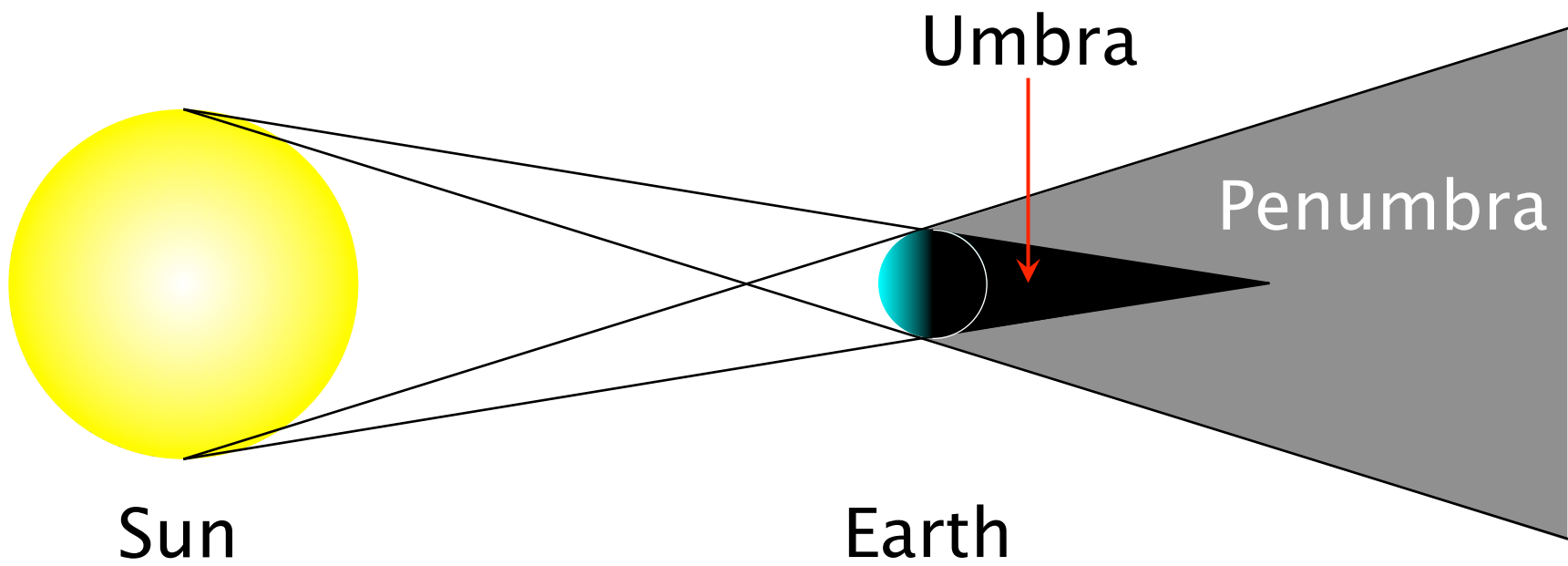
Penumbral Eclipse

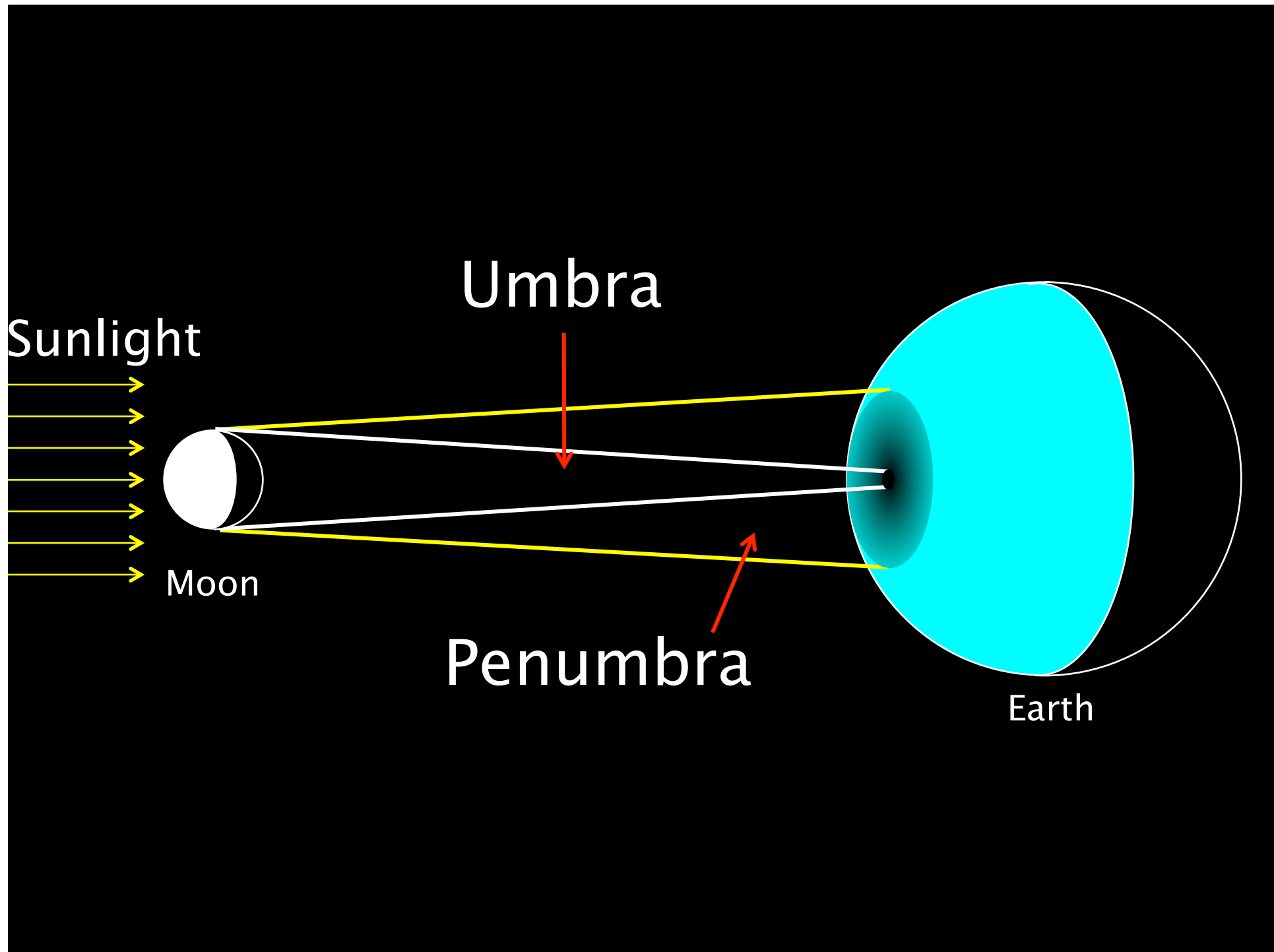


Total Lunar Eclipse



Partial Lunar Eclipse





Moon's Orbit is Elliptical: $e = 0.055$

© A. Cidadão



Moon at Perigee
 $a(1-e) = 363,000$ km

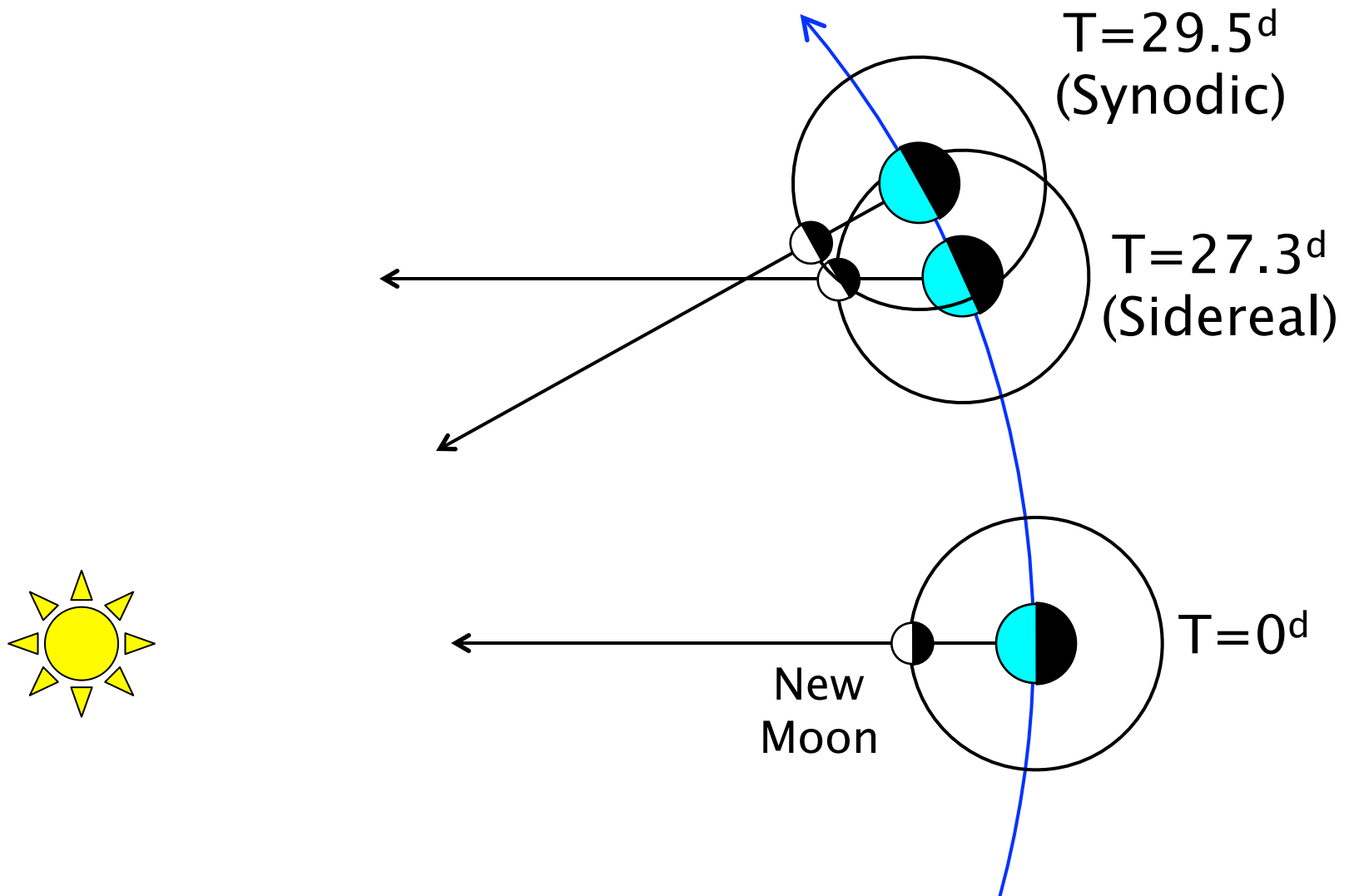


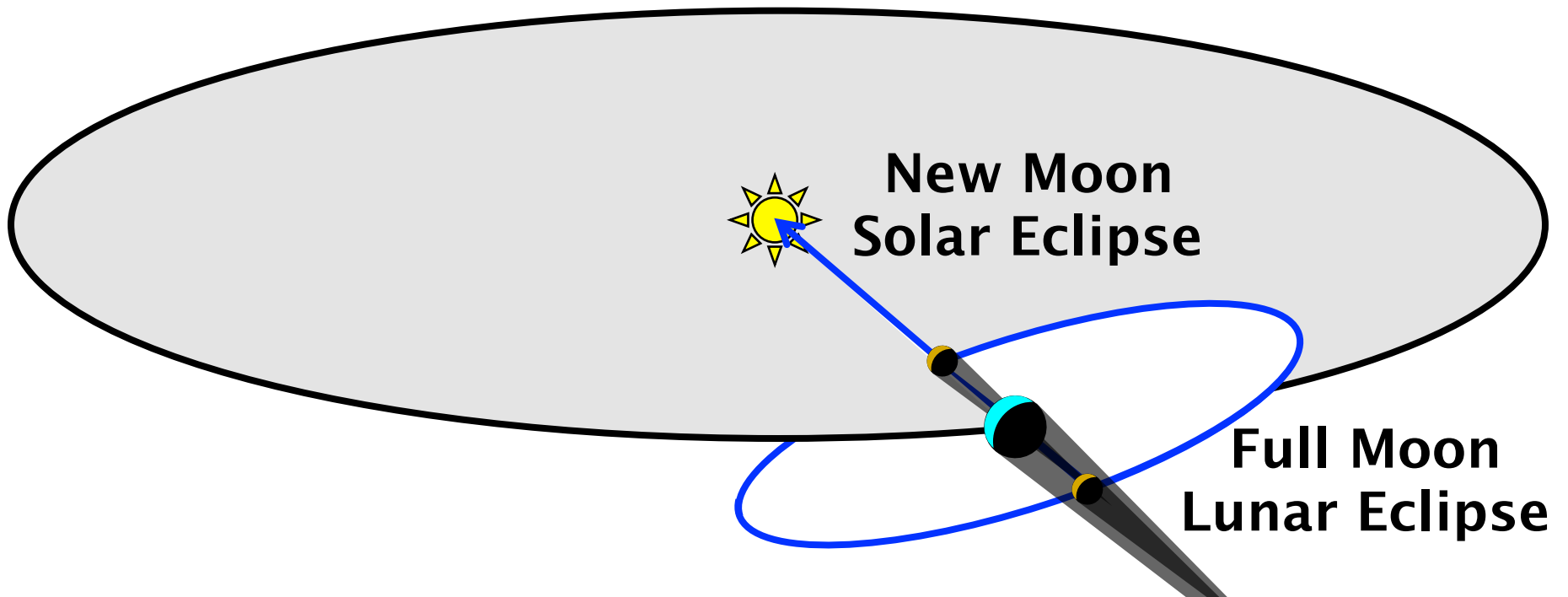
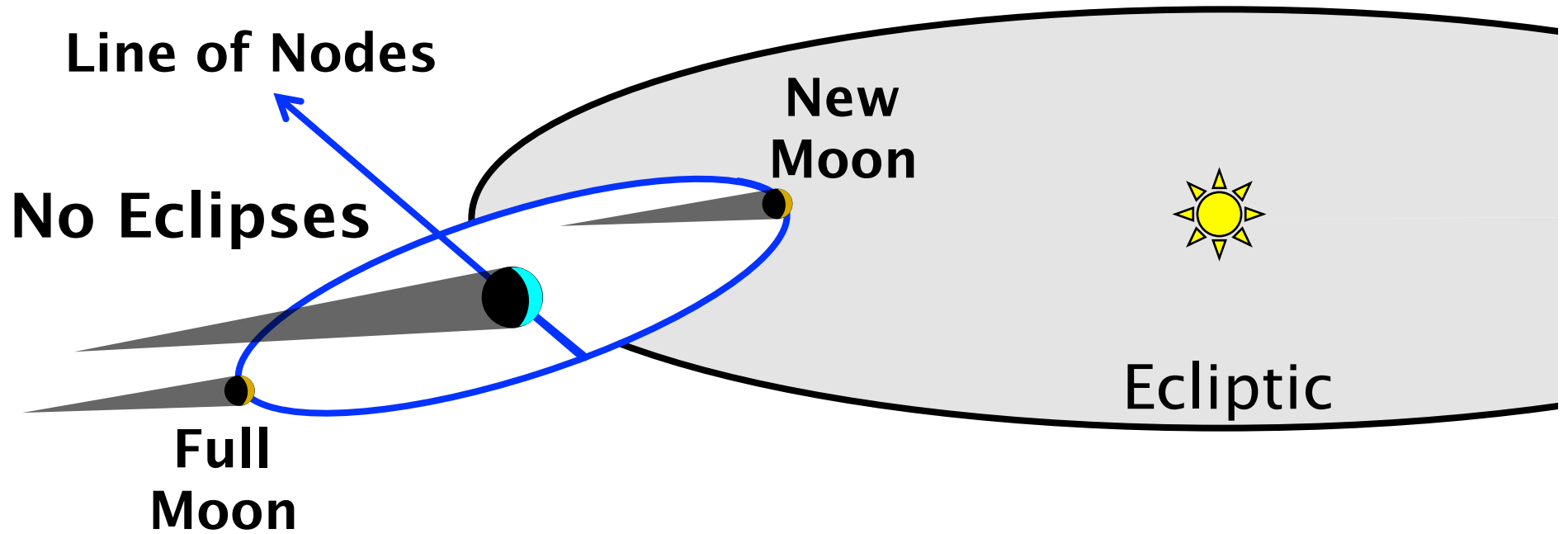
Moon at Apogee
 $a(1+e) = 405,000$ km

Annular Eclipse

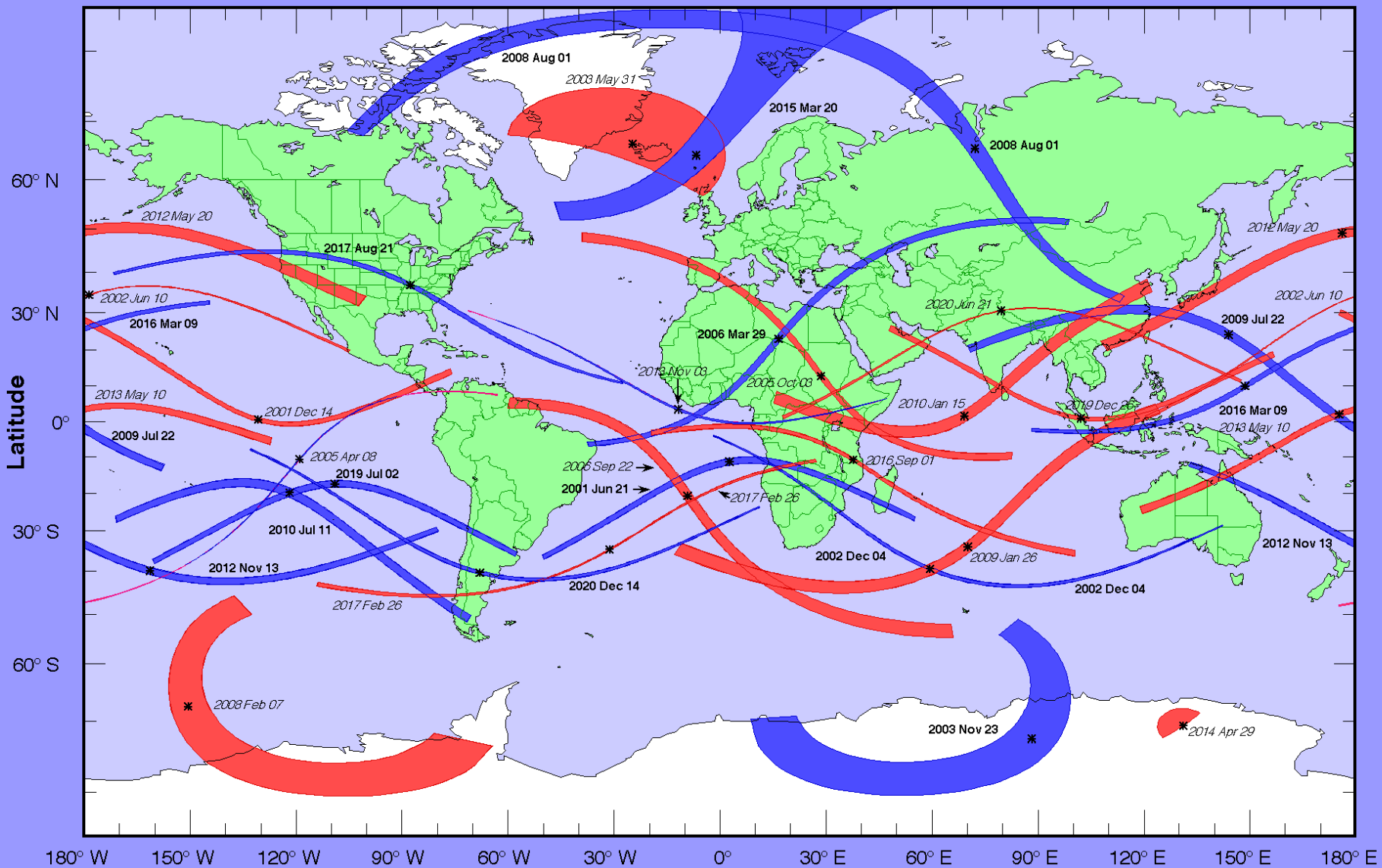


Sidereal vs. Synodic Months

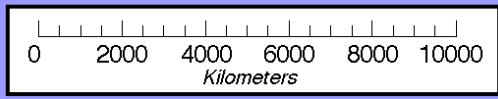




Total and Annular Solar Eclipse Paths: 2001 – 2020



- Total Eclipse
- Annular Eclipse
- Hybrid Eclipse



sunearth.gsfc.nasa.gov/eclipse/eclipse.html

Fred Espenak, NASA/GSFC - 2002 July