

ASTR 2310: Chapter 4

- **Earth-Moon System**
- Precession
- Tides
- Limits on Sizes of Orbits
- Phases of the Moon
- Rotation of the Moon
- Eclipses

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- Precession
 - We talked about this already (equinoxes, Polaris...)
 - Now a bit more on why...
 - The Earth is not a perfect sphere (what is?!)
 - The sun is not the only source of gravitational influence on the Earth
 - Also very important is the moon

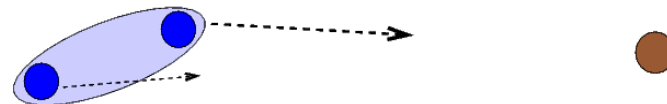
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- Precession
 - Earth's “spare tire” plus tilt means a torque from the sun and moon. See figure in text, plus:

A perfectly spherical Earth would experience no torque due to the Moon's gravitational pull



... but the equatorial bulge of the Earth acts like a dipole: the near side is pulled harder than the far side.

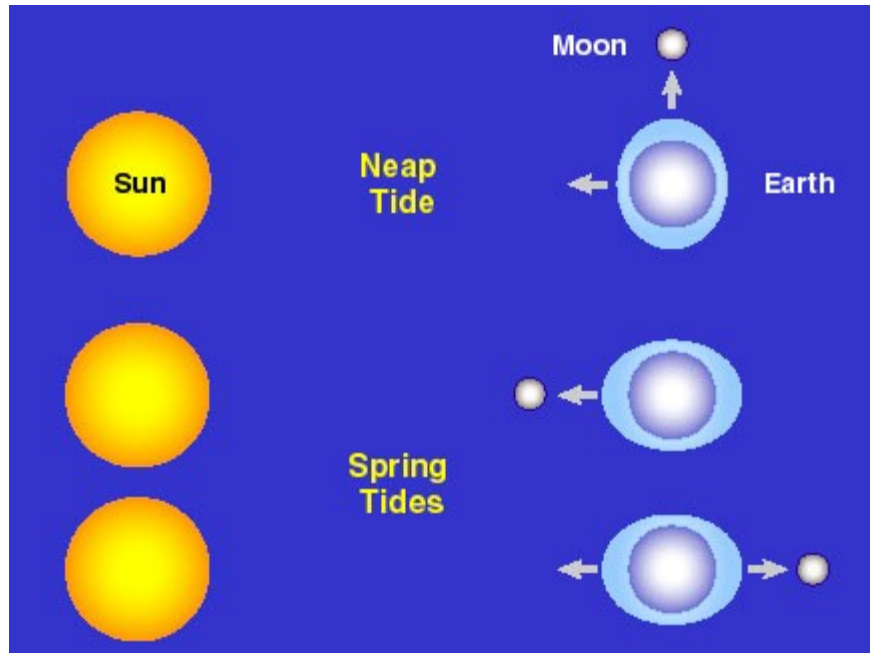


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- Tides, a related concept
 - Depends on the idea that gravity depends on distance, and the near side of the Earth is pulled on harder than the far side (again by Sun and Moon)
 - Follow derivation of tidal forces from text (p. 85-88)

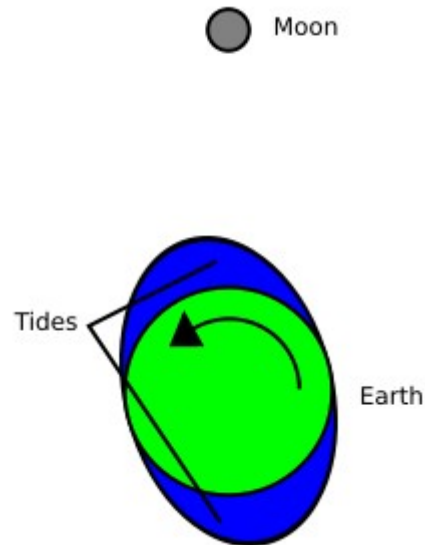
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- Tides, a related concept



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- Tidal Braking
 - Friction breaks symmetry, so bulge is retarded
 - Earth's rotation slows, Moon orbit increases
 - Math here...

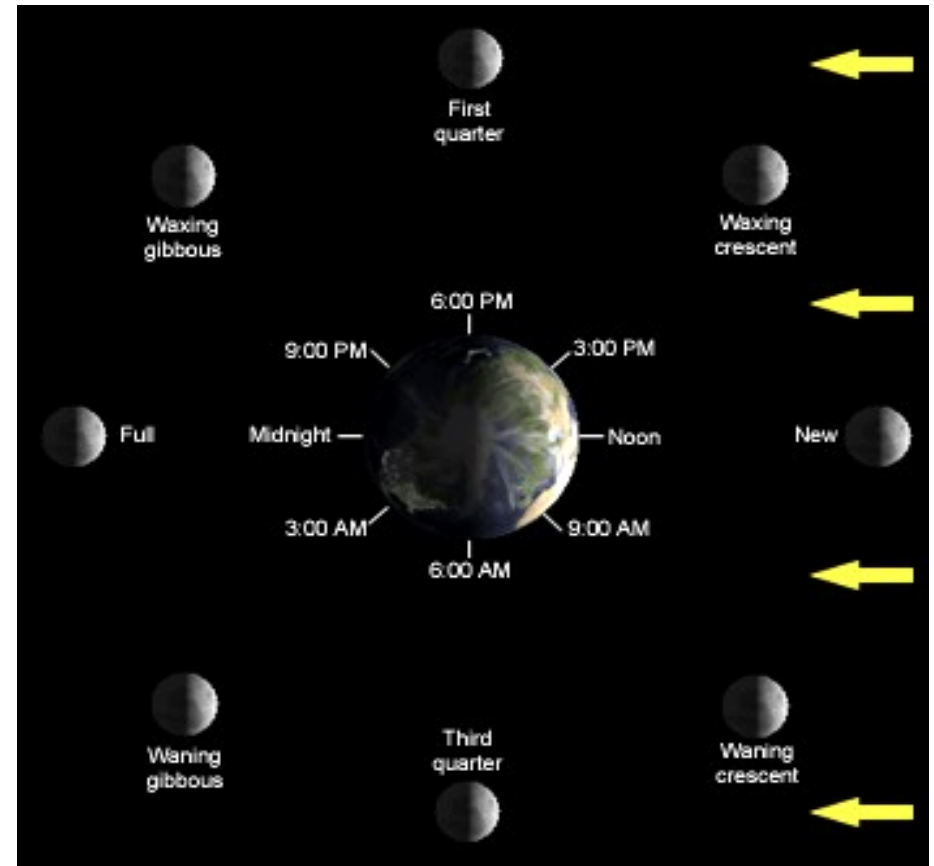
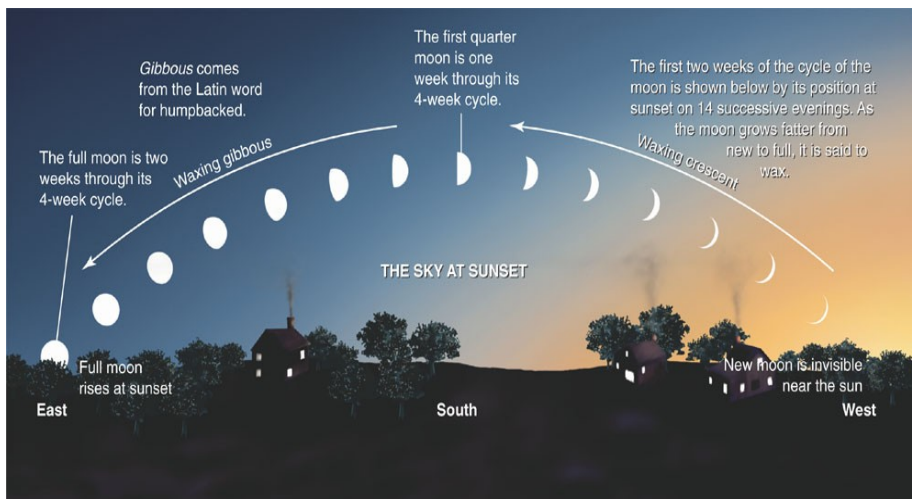


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- Limits on Orbits
 - Minimum: Roche Limit
 - Balance self gravity against tidal forces
 - Maximum: Hill Radius
 - Balance gravity of planet (Earth) vs. Sun
 - Go through the math of each on board

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- Phases of the Moon
 - Video
 - Figure
 - Quiz
 - Lab Demo



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- Facts about Moon's Orbit
 - Tilted by 5.1 degrees compared to the ecliptic
 - Sidereal vs. Synodic months
 - Derivation in text, similar to things in Chapter 2
 - $P_{\text{syn}} = 29.531$ days (e.g. new moon to new moon)
 - $P_{\text{sid}} = 27.322$ days

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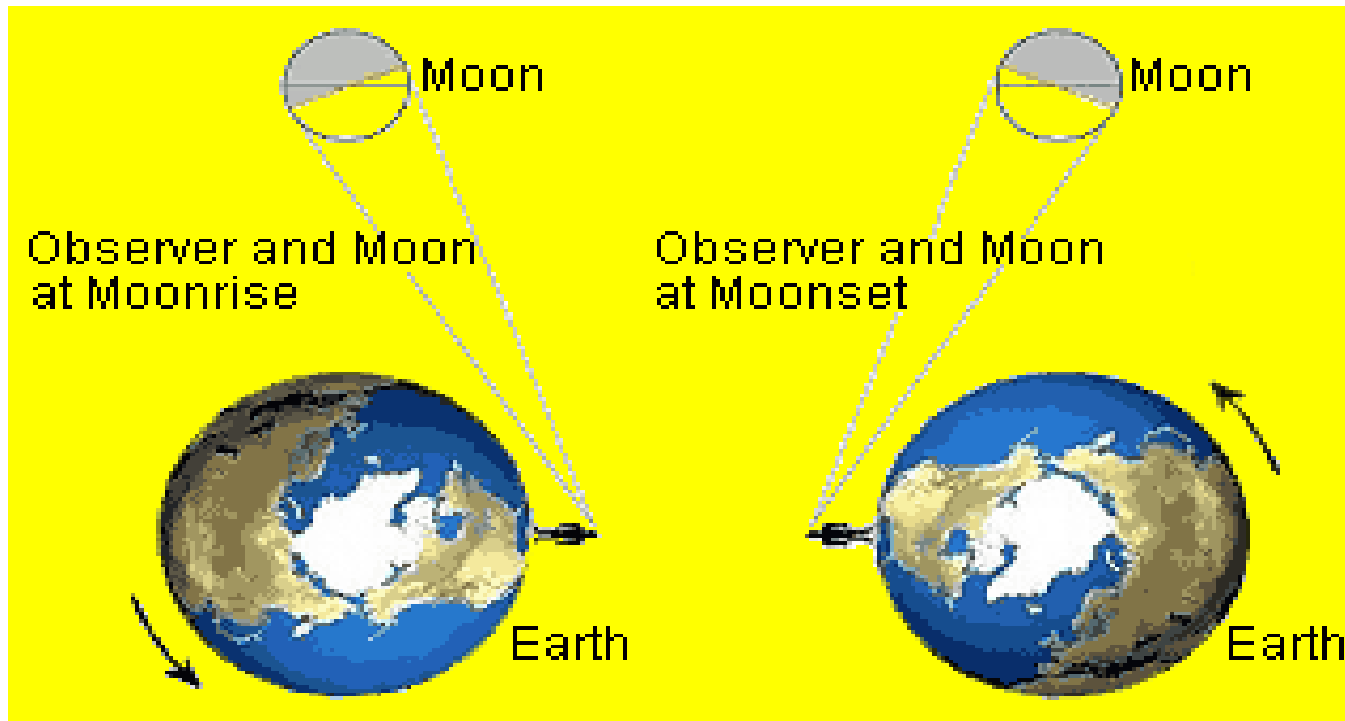
- Rotation of the Moon
 - Earth exerts larger tidal forces on moon than moon does on Earth
 - Tidal braking is more effective
 - Moon now locked into synchronous rotation
 - Issue of “Far Side” vs. “Dark Side” -- Get it right!
 - Lunar Librations...see next slide/video

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- Lunar Librations
 - Earth exerts larger tidal forces on moon than moon does on Earth
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- Lunar Librations (diurnal)
- Video:
<http://www.youtube.com/watch?v=6nTmOIkUo>



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- Lunar Librations (in longitude due to eccentricity of lunar orbit, and in latitude due to orbital tilt):

