1 The Celestial Sphere

Assign: Read Chapter 1 of Carrol and Ostlie (2006)

1.1 Geocentric Universe of the Greeks

1.2 Getting to Know the Celestial Sphere

- OJTA: 2. Overview of the Sky/The Celestial Sphere
  - (1) The Celestial Sphere
  - (2) The Ecliptic
  - (3) The Coordinate System
  - (4) Equinoxes and Solstices
  - (5) Motion on the Celestial Sphere
- OJTA: 2. Overview of the Sky/Constellations
  - (1) Groupings and Asterisms
  - (2) Classical Constellations
  - (3) Modern Constellations
  - (6) Naming the Stars
- OJTA: 2. Overview of the Sky/Aspects and Phases
  - (1) Classification
  - (4) Wanderers
  - Animation 3.2
- OJTA: 2. Overview of the Sky/Timekeeping
  - (1) Sidereal and Solar Time
  - (2) Sidereal and Solar Days
  - (3) Precession of the Earth's Axis
  - Animation 2.13
  - Animation 3.2

- (5) Inferior Planets
- (6) Superior Planets

Example Problem: Synodic and sidereal orbital period

For synodic period S and sidereal period P,

$$\frac{1}{S} = \begin{cases} \frac{1}{P} - \frac{1}{P_\oplus} & \text{(Inferior)} \\ \frac{1}{P_\oplus} - \frac{1}{P} & \text{(Superior)} \end{cases}$$

Generally, $P_\oplus = 365.26$ days and For Mercury, $P \simeq 88$ days. Thus

$$\frac{1}{S} = \frac{1}{88\text{ d}} - \frac{1}{365.26\text{ d}} = 8.63 \times 10^{-3}\text{ d}^{-1},$$

so for Mercury S = 115.9 days.

- OJTA: 2. Overview of the Sky/The Seasons
  - (1) The Northern Hemisphere
  - (2) The Southern Hemisphere
- OJTA: 2. Overview of the Sky/The Moon (be brief)
  - (1) Revolution in Orbit
  - (2) Lunar Phases
  - (3) Rotational Period
  - (4) Tidal Locking (omit details til later)

1.3 Important "Rules of Thumb"

- Sun and Moon subtend about 1/2 degree (width of outstretched thumb)
- The sky appears to turn

$$\frac{360^\circ}{24\text{ hr}} = 15^\circ/\text{hour} \quad \text{(Width outstretched pointer and pinkie)}$$

$$\frac{360^\circ}{24 \times 60} = 0.25^\circ/\min \quad \text{(Width outstretched thumb every 2 minutes)}$$

This means that the sky turns about 1° every 4 minutes.

- The Sun drifts eastward on the ecliptic

$$\frac{360°}{365.25} \simeq 1° \text{ per day}$$

- The Moon drifts eastward with respect to the constellations

$$\frac{360°}{27.3} \simeq 13.2° \text{ per day}$$

$$(13.2/15) \times 60 \simeq 52.8 \text{ minutes later rising per day}$$

1.4 Angular Measure

- 360° in circle
- $\left(\frac{1}{60}\right)^{\circ} = 1$ arcminute ($'$)
- $\left(\frac{1}{60 \times 60}\right)^{\circ} = \left(\frac{1}{3600}\right)^{\circ}$ = 1 arcsecond ($''$)
- 1 radian (rad) = $\frac{180}{\pi} \simeq 57.3°$
- 1 arcsecond = 4.848×10^{-6} rad

> One arcsecond is the angle subtended by a dime viewed at a distance of 2 km! Many properties in astronomy require measuring angles of this size or smaller.