

# Introductory Astronomy

Week 1: Positional Astronomy

Clip 5: Tilt and Seasons

# It *Tilts*

- Earth's axis is tilted  $23.5^\circ$
- Celestial equator tilted  $23.5^\circ$  from plane of orbit – ecliptic
- Sun's orbit along Celestial sphere – ecliptic - tilted  $23.5^\circ$  from Celestial equator
- Sun's Declination changes between  $23.5$  and  $-23.5$
- Ecliptic meets equator at Vernal/Autumnal equinox at 0h/12h RA

# Seasons

- When Sun North/South of equator
  - Days longer in North/South
  - Sun higher in the sky in North/South
  - Climate warming in North/South cooling in South/NorthInside Arctic circle Sun becomes circumpolar/never rises (reverse for Antarctic circle)
- At equinox day/night equal everywhere
- Between tropics Sun is at Zenith once a year

# How High is Sun at Noon?

- Athens is at Latitude 37.7N
- At equinox
- At summer solstice
- At winter solstice

# Why Mean?

- 24h is an **average** Solar day
- Sun's **RA** increases over the year but not **uniformly**
- Sun moves around **ecliptic** almost uniformly but ecliptic is **tilted** near **equinoxes** and **parallel** to equator near **solstices**. So **Eastward** motion fastest near solstices.
- Almost... Earth very slightly nearer Sun in January

# It Also Wobbles

- The Earth's axis **wobbles** like a spinning top – **precession**
- Celestial **axis** wobbles.
- North pole **moves** to the **West** in a circle of radius **23.5°** every **26,000 years** relative to **stars**
- So does **celestial equator** hence **precession of the equinoxes**
- Coordinates of stars change too – **epoch J2000**
- Age of **Pisces** gives way to age of **Aquarius** ca. **2600**

# Credits

- Sky Simulation: Starry Night  
<http://www.starrynight.com/>
- Astronomy Animations: University of Nebraska-Lincoln Astronomy Education Group  
<http://astro.unl.edu/>