#### Daily & Seasonal Motion Introduction

#### **Daily Rising and Setting**

- Due to the rotation of the Earth around its axis
- Period of rotation:
  1 siderial day= 23<sup>h</sup>56<sup>m</sup>4.1<sup>s</sup>
- 1 solar day (Noon to Noon) =  $24^{h}$
- Stars rotate around the North Star Polaris
- How are these rotations different?



# Daily Motion: View changes in hours



(a) Earth as seen from above the north pole

(b) 4 hours (one-sixth of a complete rotation) later

## The Apparent Motion of Stars at Different Latitudes



a) At middle northern latitudes



(b) At the north pole



(c) At the equator

- Apparent motion: motion as it appears in the sky
- This is due to the position (latitude) of the observer on earth, and the fact that the earth rotates about its axis
- This can also be explained by a competing theory: that there is a celestial sphere which rotates around the motionless earth.

These different star movement patterns made it obvious to humans early on that we live on a sphere



• Change your observation spot on the spherical earth, and you will change the pattern of motion you observe

Mid-Northern Latitudes: Typical Rising and Setting pattern as the Celestial Sphere rotates around the CNP



North

The View from 35° North Latitude

 Do not confuse southern stars (½ the celestial sphere, those closer to the SCP) With the stars in \*your\* southern part of the sky



At 35 north latitude:

- the north celestial pole is 35 above the northern horizon
- the south celestial pole is 35 below the southern horizon

Seasonal Motion: View changes in months

 At the same time, say midnight, different constellations are high in the sky if you observe a month or so later (or earlier)



## Daily and yearly motion intertwined

#### Solar vs Siderial Day

- Earth rotates in  $23^{h}56^{m}$
- also rotates around sun
- → needs 4 min. to "catch up"

Consequence: stars rise 4 minutes earlier each night (or two hours per month, or 12 hours in ½ year)



→After 1/2 year we see a completely different sky at night!

#### **Seasonal Motion**

- Daily Rising and Setting:
  - Due to the rotation of the Earth around its axis
  - Period of rotation: siderial day= 23<sup>h</sup>56<sup>m</sup>4.1<sup>s</sup>
  - -1 solar day (Noon to Noon) =  $24^{h}$
  - Stars rotate around the
    North Star Polaris (Anim)
- Seasonal Changes:
  - Monthly differences caused by Earth's orbit around sun
  - <u>Animation</u>



#### The Zodiac throughout the Year



Example: In Winter sun in Sagittarius, Gemini at night sky; in summer sun in Gemini, Sagittarius at night sky

#### The Sun shifts its position on the Celestial Sphere. Therefore its visibility changes seasonally



#### Homework

- Figure out maximal altitude of the sun in these steps
  - Where is NCP (what is its altitude angle)?
  - Where is therefore the celestial equator?
  - How high is the sun on the celestial sphere above/below the celestial equator?
  - Add or subtract this angle from the altitude of the celestial equator

#### The Ecliptic plane & the Ecliptic





(b) It appears from Earth that the Sun travels around the celestial sphere once a year

#### Zodiacal signs vs. Constellations

# •"Constellation" is a modern, well-defined term

- Some constellations are big, some are small on the celestial sphere

•"Zodiacal sign" is the old way of dividing the year and the Sun's path into 12 equal

parts

- 360/12=30, so each zodiacal sign is exactly 30 degrees "long"
- 0 degrees: Aries, 30 degrees: Taurus, 60 degrees: Gemini, 90 degrees: Cancer, etc.

