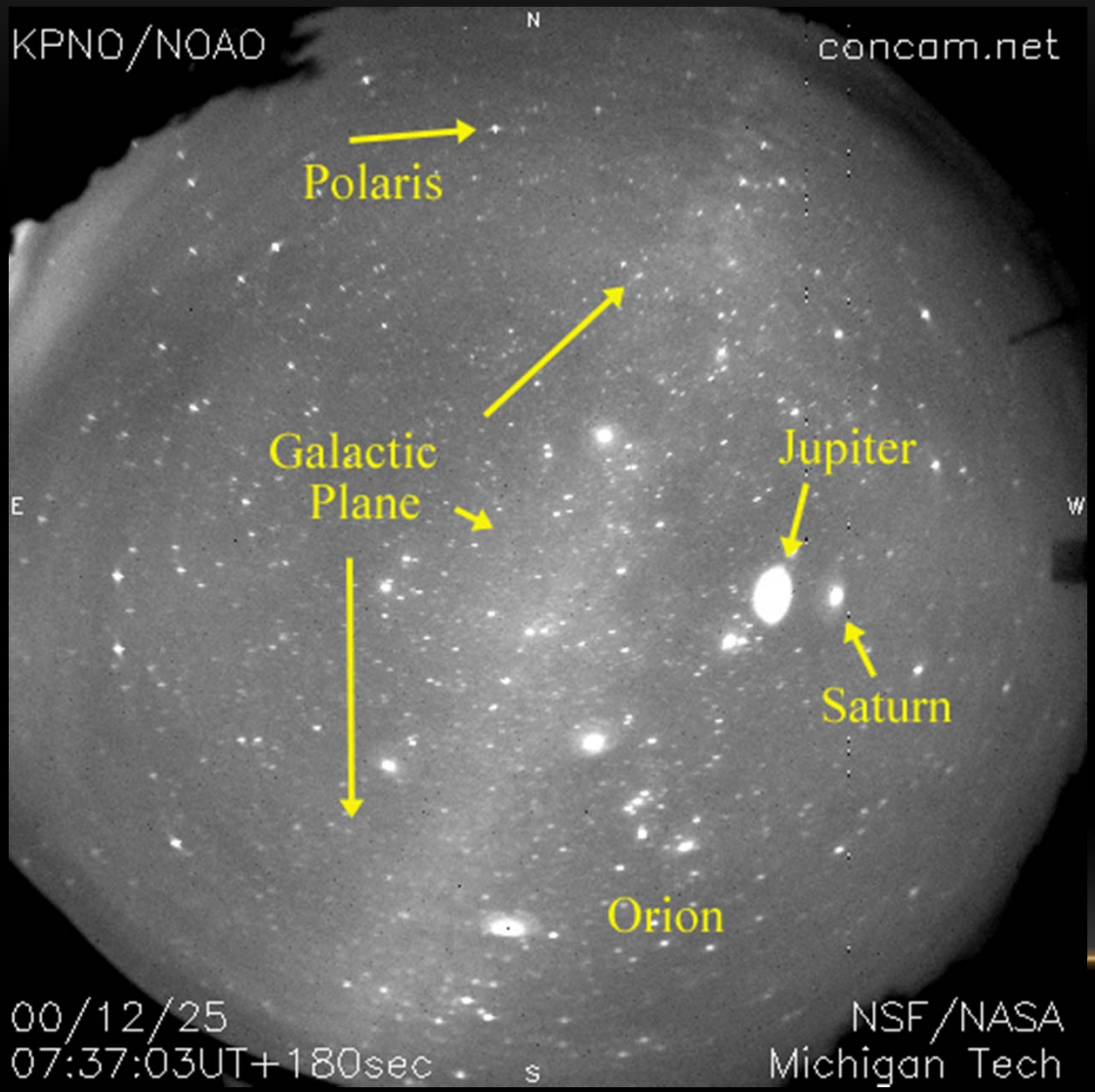
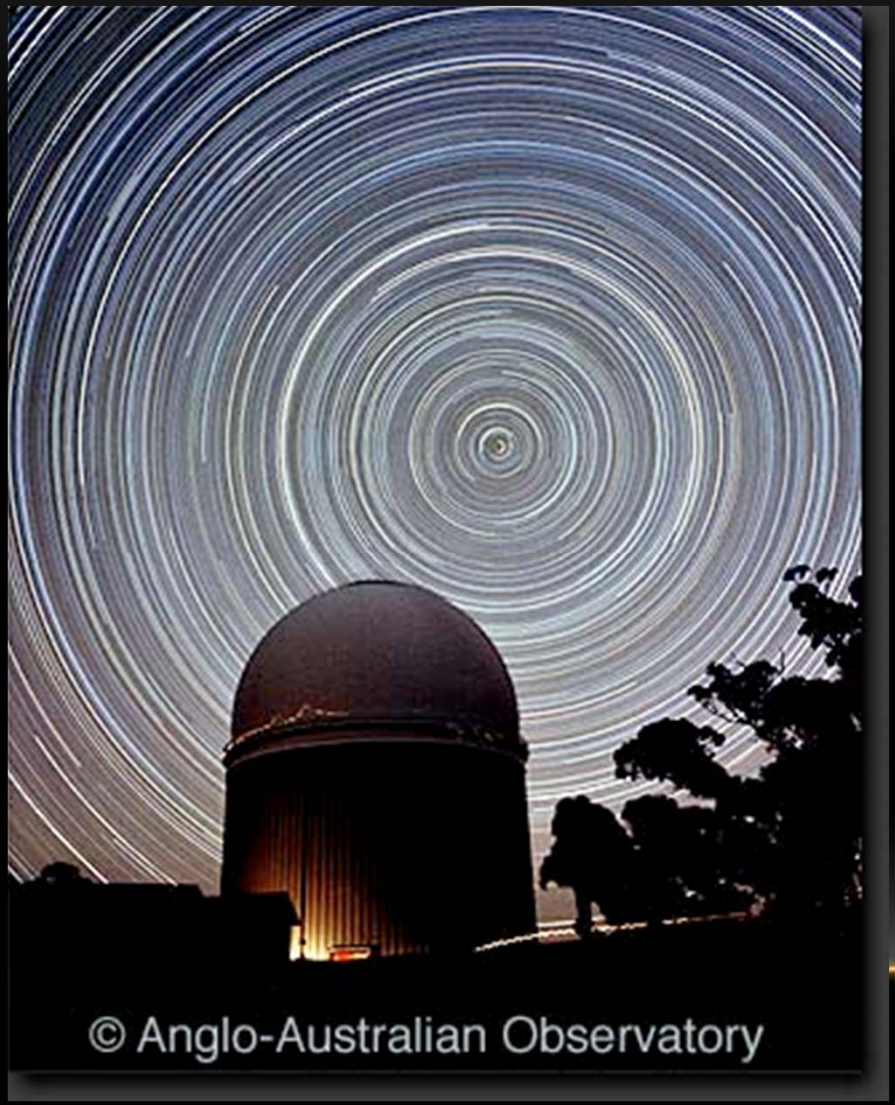
VIEW FROM EARTH



- A composite of the night sky for a whole night
- Like looking up into a bowl painted with stars
  - "Celestial Sphere", more later on this

CONCAM project, KPNO, 12/25/00

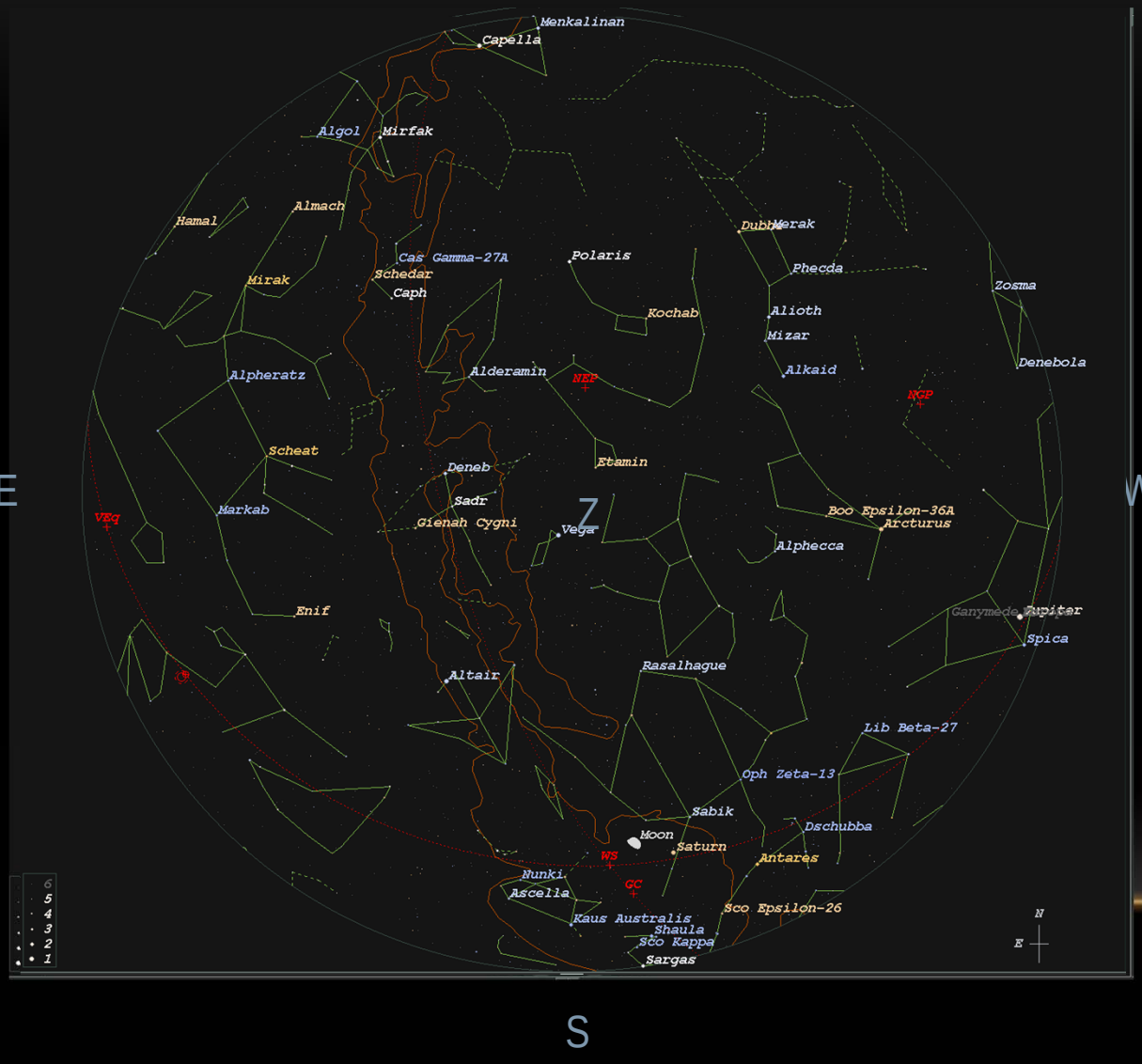
OVER A WHOLE NIGHT…



- We see the stars spin around the pole
  - This is the south celestial pole, seen from Australia
  - We see the same thing around the North Celestial Pole (near the star “Polaris”)

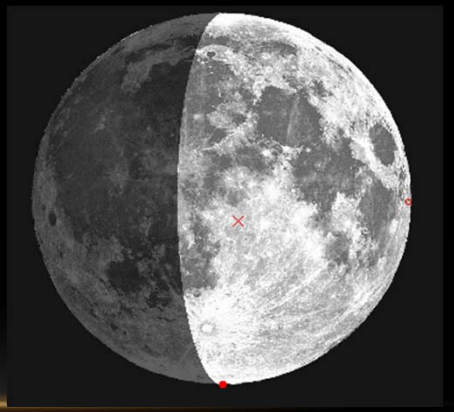
Photo by David Malin, AAO

TONIGHT



- 20:00 Aug 30
- Whole Sky

Moon tonight looks like:



Only 61% illuminated,

Full Moon is a week away

WHAT DO YOU SEE?

- Early evenings are pretty nice this time of year.
  - Go look at what's being talked about in class!
  - Grab a pair of binoculars, you will be pleasantly surprised (but don't expect colorful close-ups like in the book)
  - Look at Moon!!
- Note the light pollution
  - What can be done?

WHAT DO YOU SEE?

- Standing outside looking up, sky looks like a hemisphere
  - Zenith straight up, Meridian is line from N-S

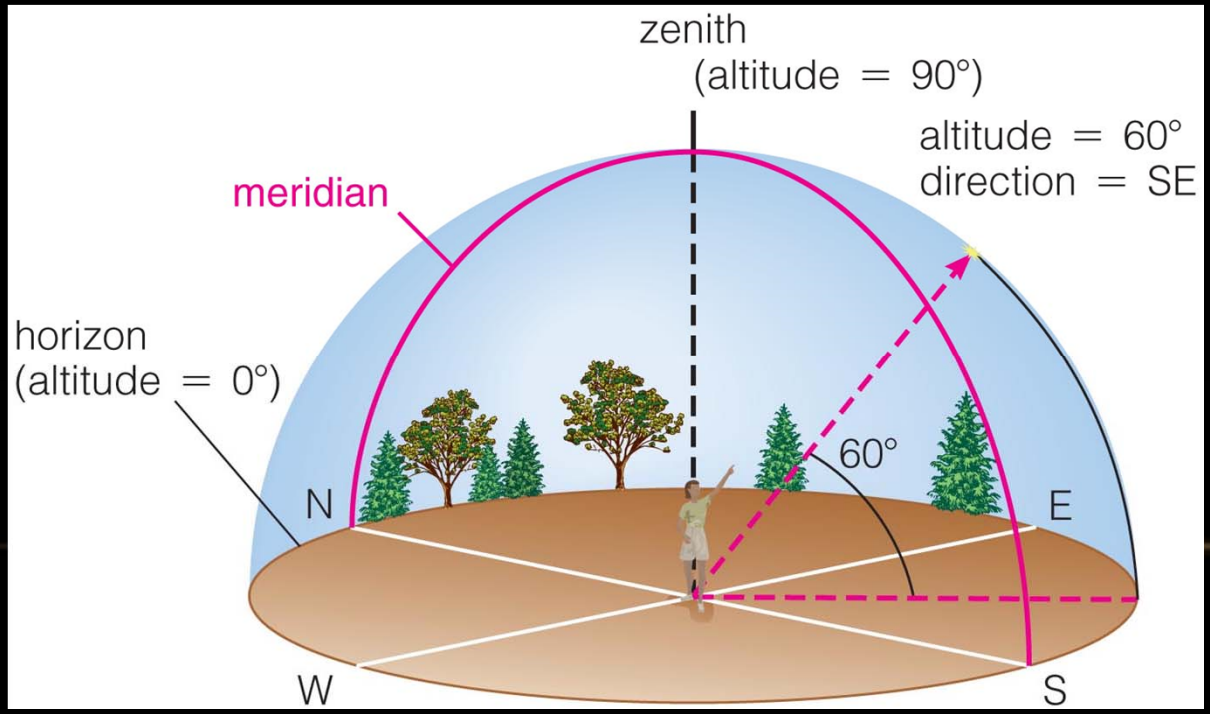


Fig.2.6

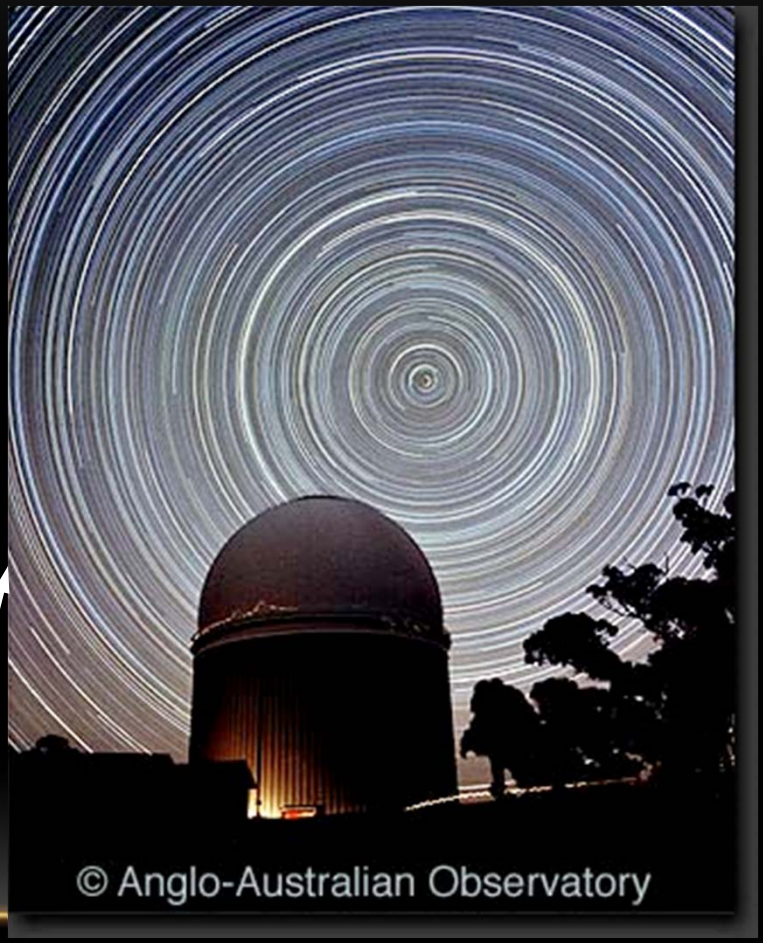
THE CELESTIAL SPHERE

- is the Sky – as if it were a glass ball and we were at the center
- Stars appear fixed on this sphere
- It rotates as if it were on a rod run through the Celestial Poles (North & South)
- Stars are fixed points of light on this sphere. Patterns form Constellations
  - These also divide the sky up into areas

THE CELESTIAL SPHERE

- Silly? But that's what it looks like.
  - Sit around outside for a few hours and see
  - Or, try this java applet:
  - http://physics.weber.edu/schroeder/sky/skymotionapplet.html

PLAY



Circumpolar stars never rise or set

THE CELESTIAL SPHERE

- A different perspective
- Celestial poles, equator are projections of Earth's
- Ecliptic is path the sun appears to take around the sky over a year

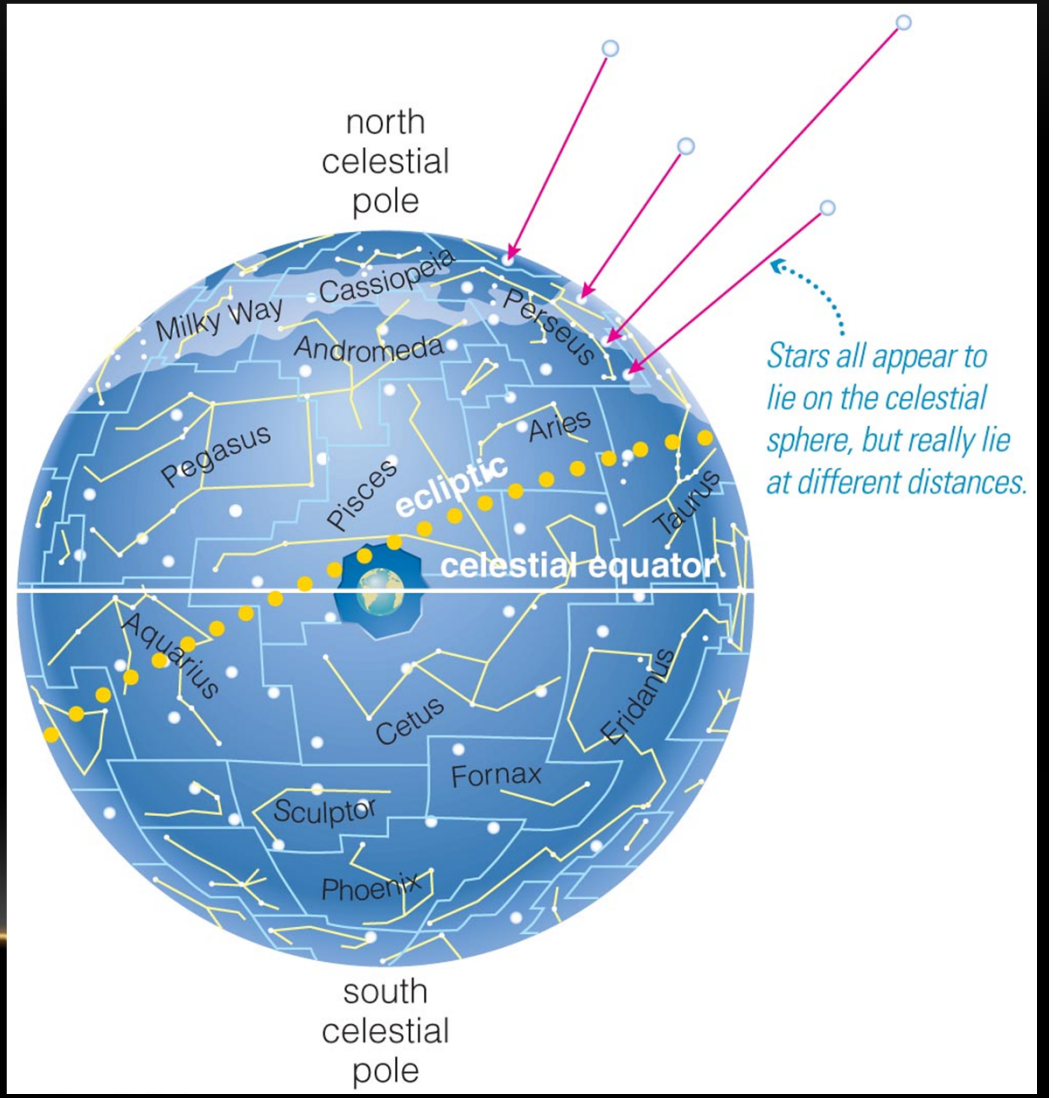
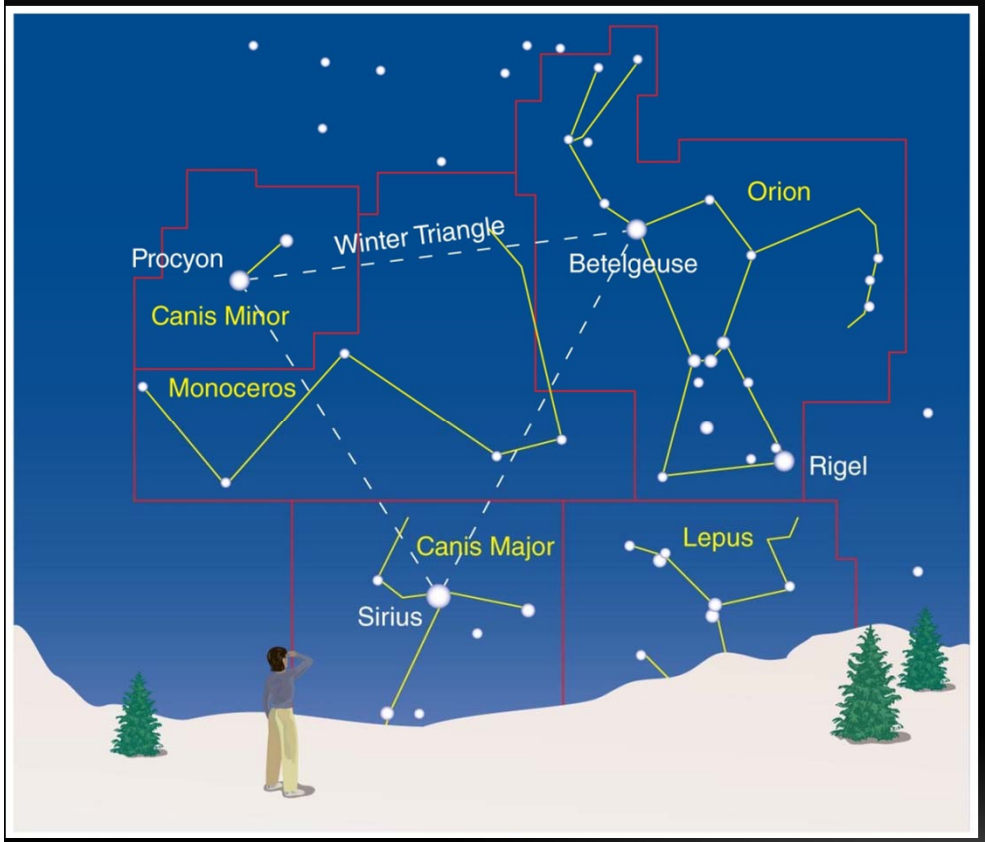


Fig.2.3

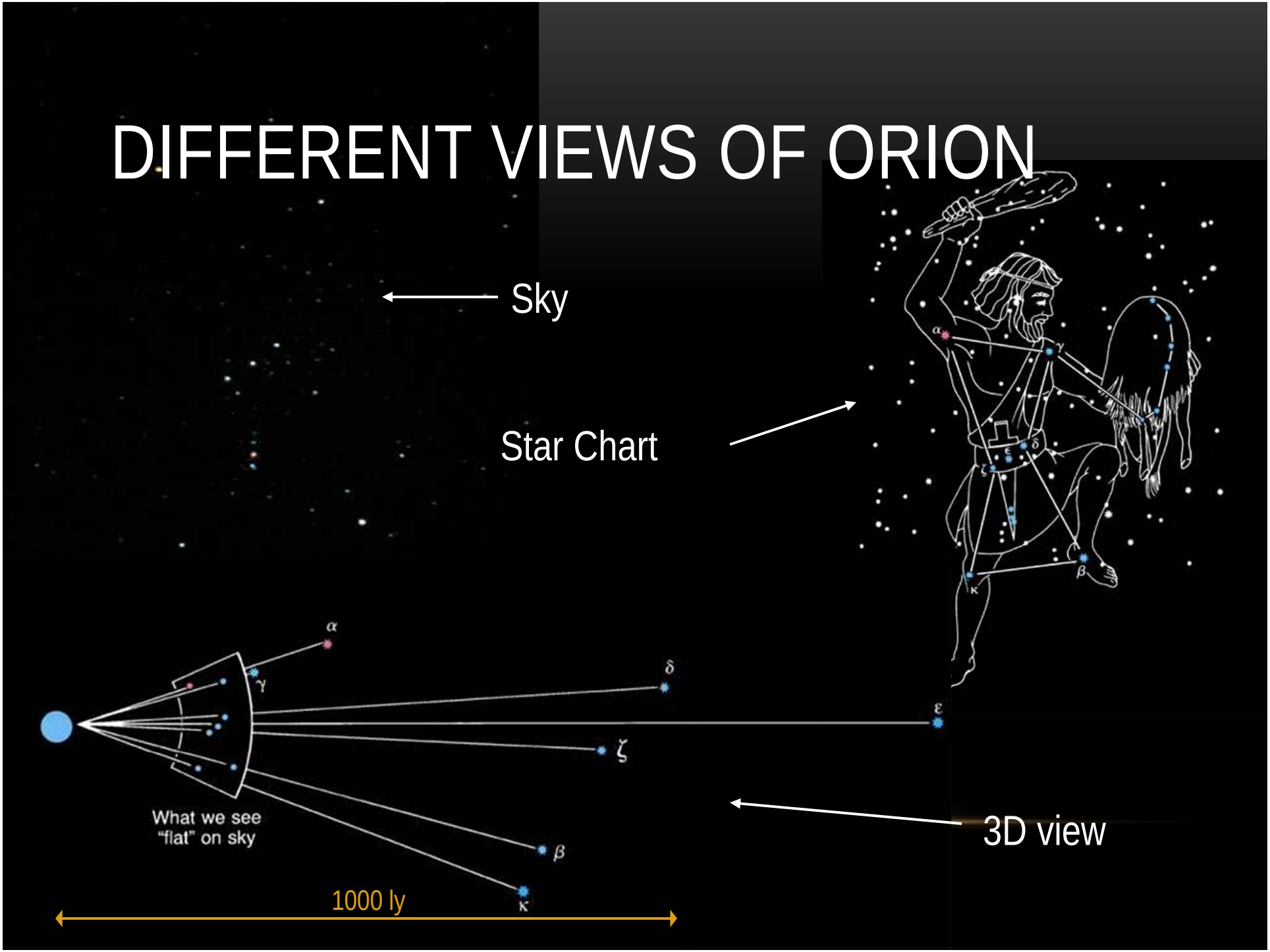
CONSTELLATIONS



- Started as fanciful patterns, as old as civilization
- Now areas on the sky, exact boundaries were decided by the IAU
- There are 88 – about half are old Greek/Roman
  - Newer ones such as “Microscopium” very un-mythical
- See class website for link to Big List of names

Fig.2.2

DIFFERENT VIEWS OF ORION



NOTES ON CONSTELLATIONS

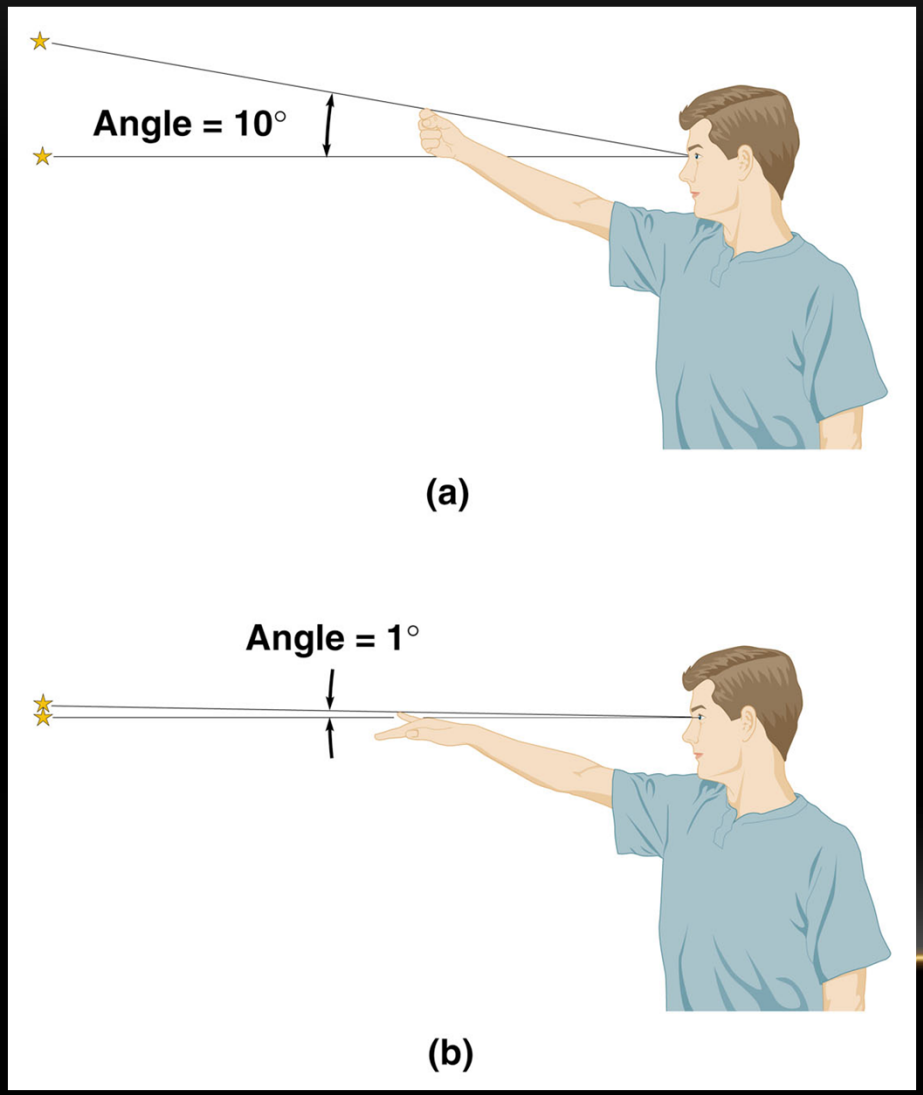
- They are 2-D projections of random 3-D distributions of stars in space
- Size of star on picture, sky chart related to brightness – not actual size
  - All stars are so far away they appear as points
  - Planets can be seen as disks (also why they don't twinkle)
- Over a really long time, *proper motion* will change their shapes a bit

THE BIG DIPPER

Animation from “The Astronomy Nexus”

- An *Asterism* not a Constellation
- Left - the proper motion in the Big Dipper, over 100,000 years
- These stars are pretty close to us
- 5 are actually an “Association”, or loose group

POSITIONS



- Angular Separation
- What's the angle between two things we see?
- Or size -
  - Moon, Sun ~0.5^{o} wide

DEGREES, MINUTES, SECONDS

- Measured in:
  - Degrees
  - minutes (1/60th of a degree)
  - seconds (1/60th of a minute)

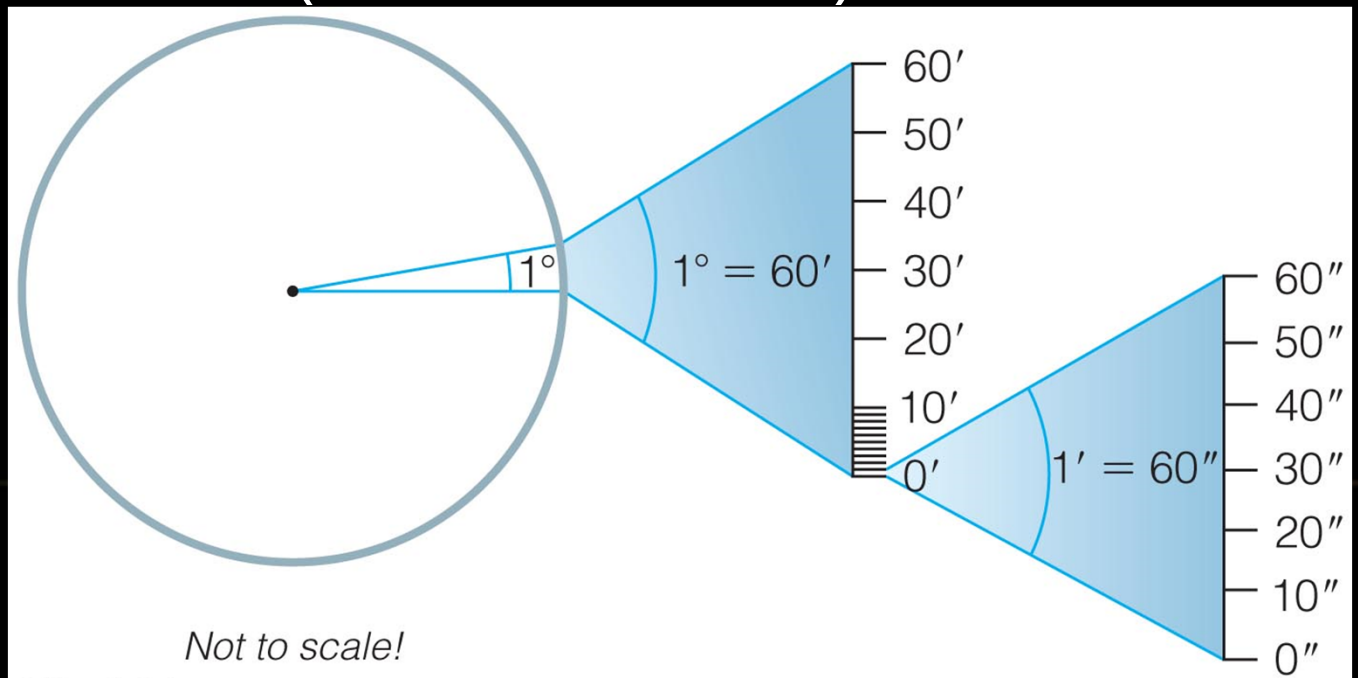


Fig.2.8

MOON ON THE HORIZON

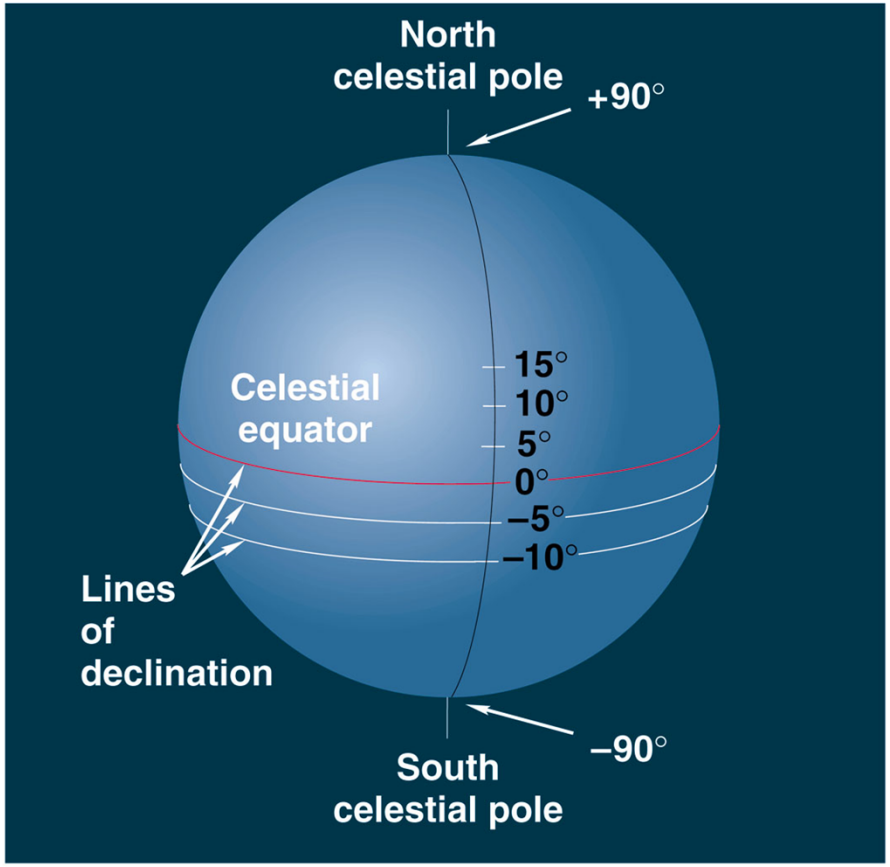
Picture by Shay Stephens

- Image of moonrise
  - Over Seattle
  - Multiply exposed every 2.5 minutes
  - Last exposure long
- Note moon stays the same size – 0.5^{o}
- From Astronomical Picture of the Day
  - See class website for link

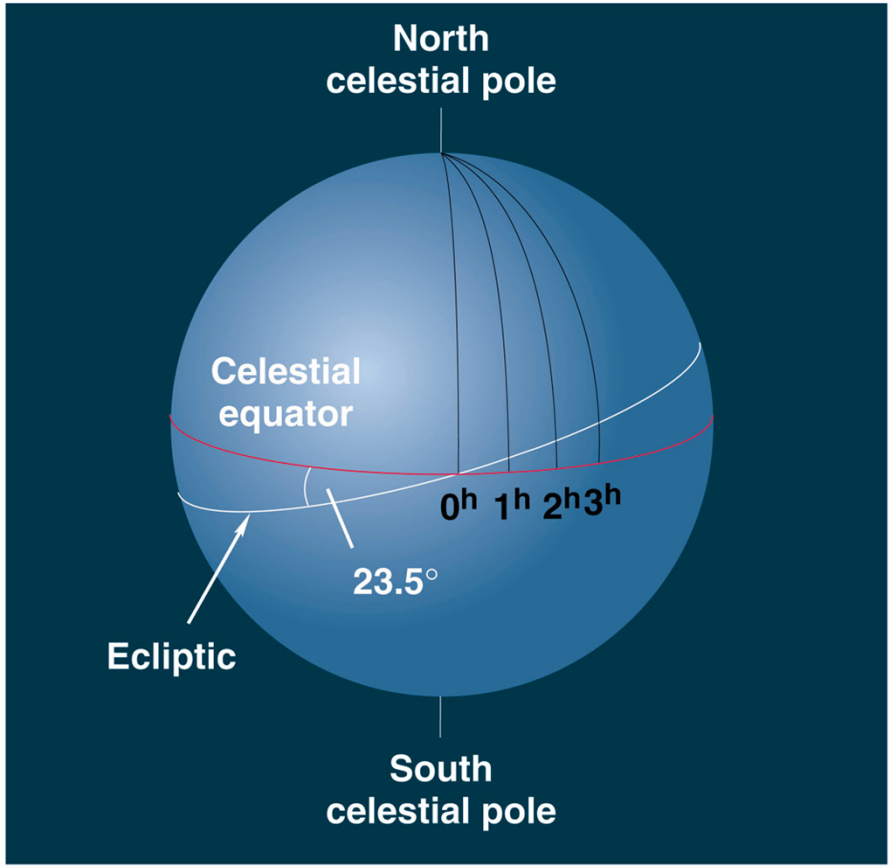
CELESTIAL COORDINATES

- The Earth has latitude and longitude, poles, and an equator.
- Project those onto the sky – so now each part of the sky also has a coordinate *(like in "Battleship")*
  - Declination is like latitude, measured in degrees north or south of the equator
    - *e.g.*, Betelgeuse is at Dec +7º24'24.0"
  - Right Ascension is like longitude, but is measured in hours, minutes, and seconds (24^h makes the whole circle)
    - *e.g.*, Betelgeuse is at RA 5hr, 55min,10.3s (or $5^h55^m.17$)

CELESTIAL COORDINATES



(a)

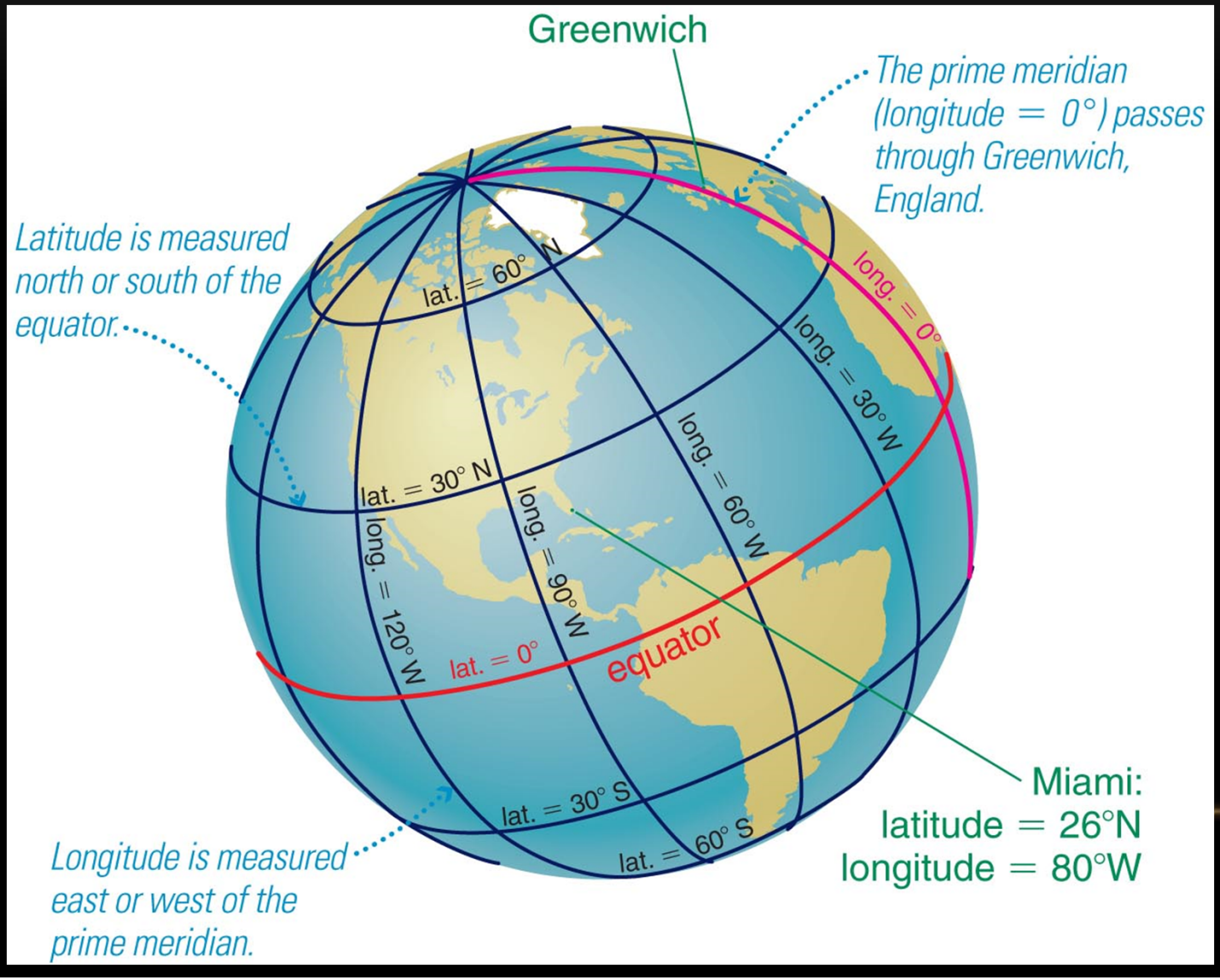


(b)

MOTIONS ACROSS SKY

- The Stars move across the sky
  - from East to West
  - complete trip is one *sidereal day* (23^h56^m)
  - stay fixed relative to each other
- We saw this animation already…

EARTHLY COORDINATES

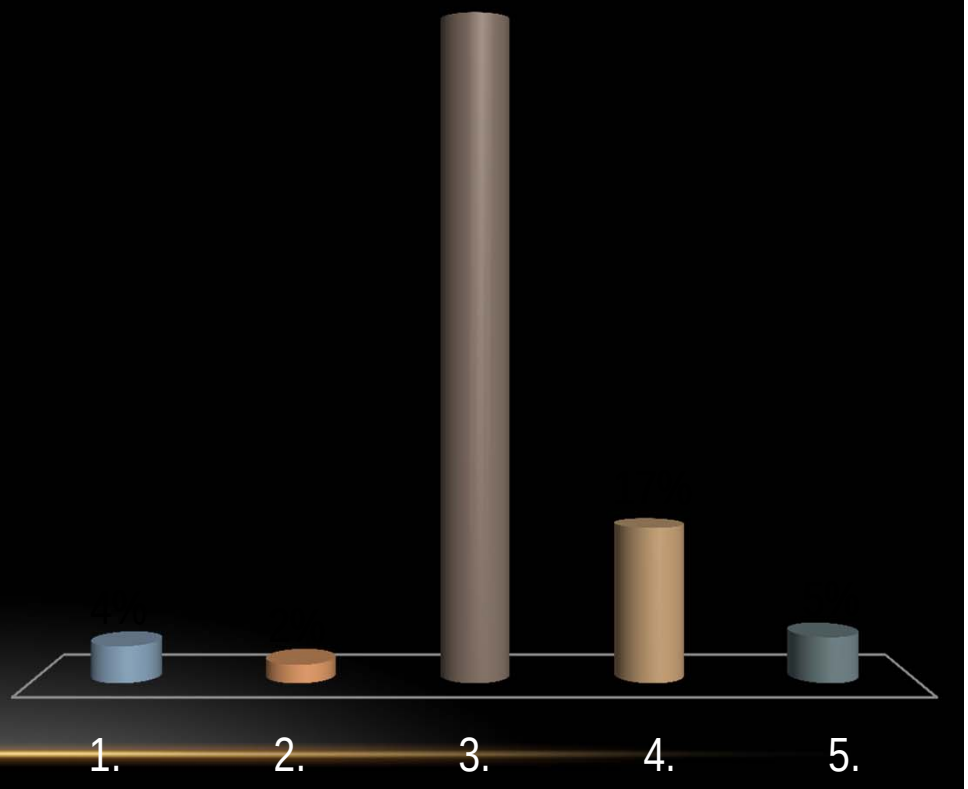


Duluth is at:
46º46’56” N
92º06’24” W

Fig.2.11

THE NORTH STAR (POLARIS) IS 50° ABOVE YOUR HORIZON, DUE NORTH. WHERE ARE YOU?

1. You are on the equator.
2. You are at the North Pole.
3. ✓ You are at latitude 50°N
4. You are at longitude 50°E.
5. You are at latitude 50°N and longitude 50°E.



LOCAL COORDINATES

- Horizon: Line where Sky meets Earth
- Zenith (straight up), Nadir (Straight down)
- Meridian
  - Line from N to S through Zenith
  - Things are at their highest point in the sky when they cross the Meridian
- To point a telescope:
  - Altitude (angle above Horizon)
  - Azimuth (angle around the Horizon)

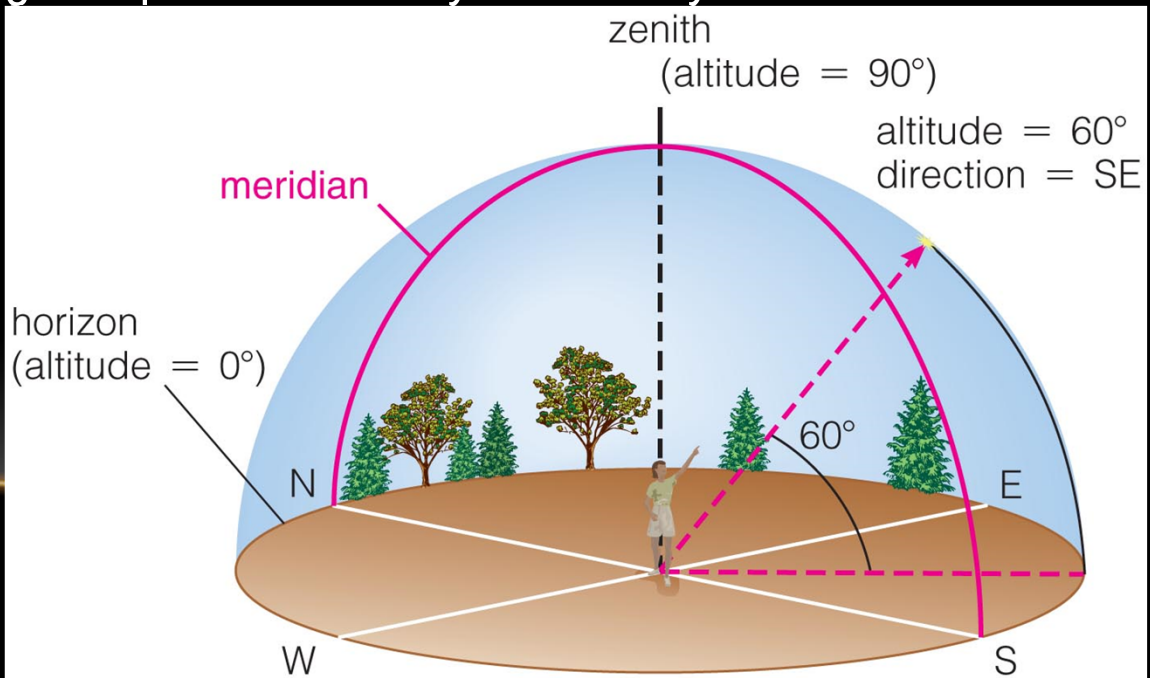


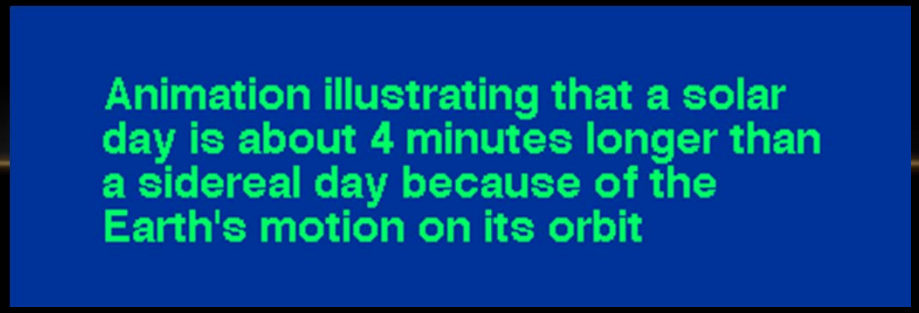
Fig.2.6

MOTIONS ACROSS SKY

- The Sun moves across the sky: in a day
  - from East to West
  - Complete trip is one *solar day* (24^h)
  - moves by ~1^o/day compared to the stars, from West to East
  - Almost just like the stars
- In a year:
  - Moves along *ecliptic* – a path inclined by 23.5^o from the celestial equator due to the tilt of the Earth's axis

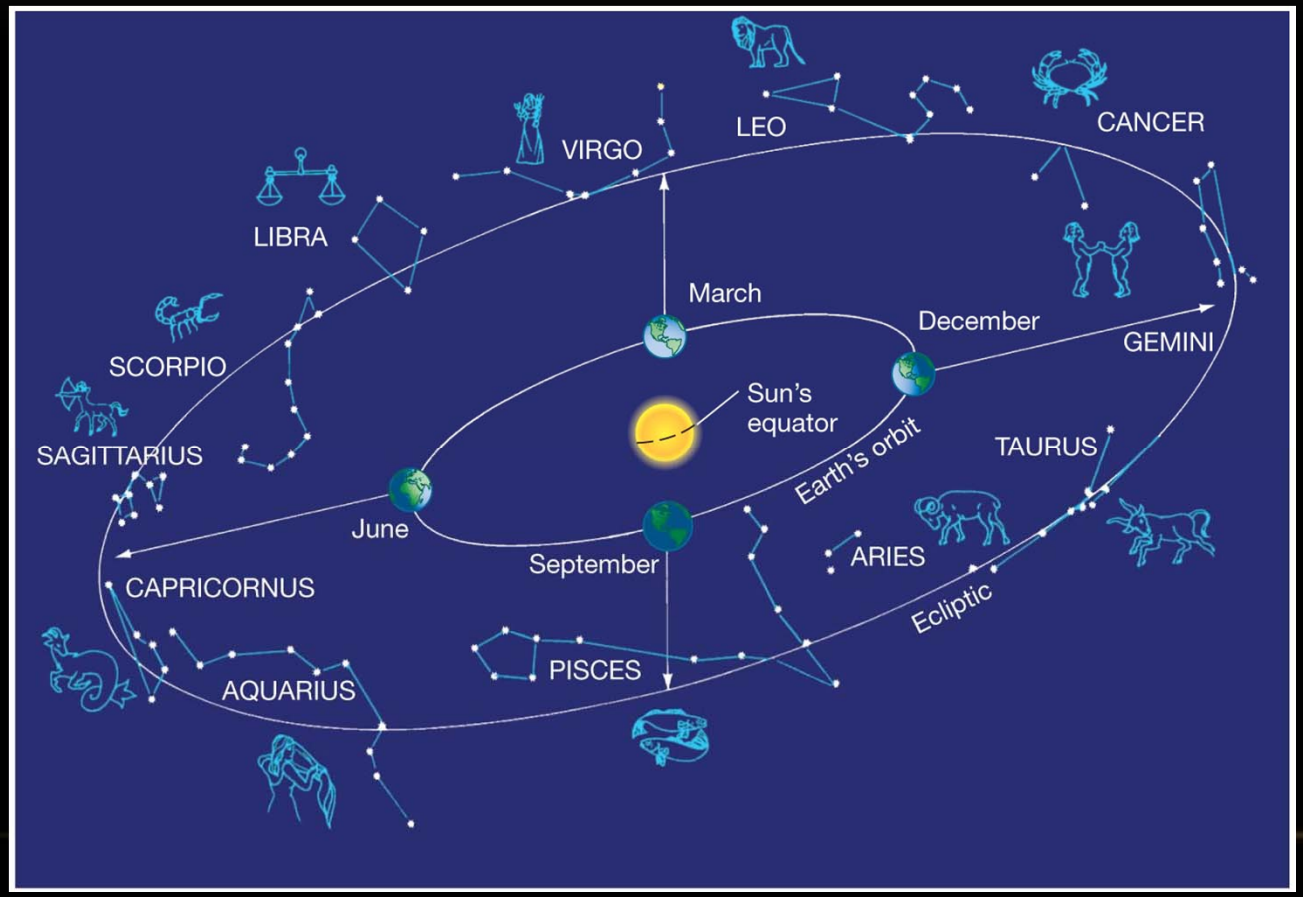
WHY THE DIFFERENCE IN A DAY?

- The Earth rotates on its axis once every 23^h56^m, causing our view to spin
- The Earth orbits the Sun once every ~365.25 days
  - So Sun makes a complete 360^o trip around the sky once per year
  - It takes an extra 4 minutes of Earth's rotation for our view to catch up with the ~1^o movement of the Sun compared to the background stars!



Animation from Univ. of Tennesee's online astro course

PATH OF SUN ALONG ECLIPTIC



ECLIPTIC ON THE CELESTIAL SPHERE

- Or, projected on the celestial sphere:
  - http://www.youtube.com/watch?v=2-Ttcfmbrkl

Unrolled: