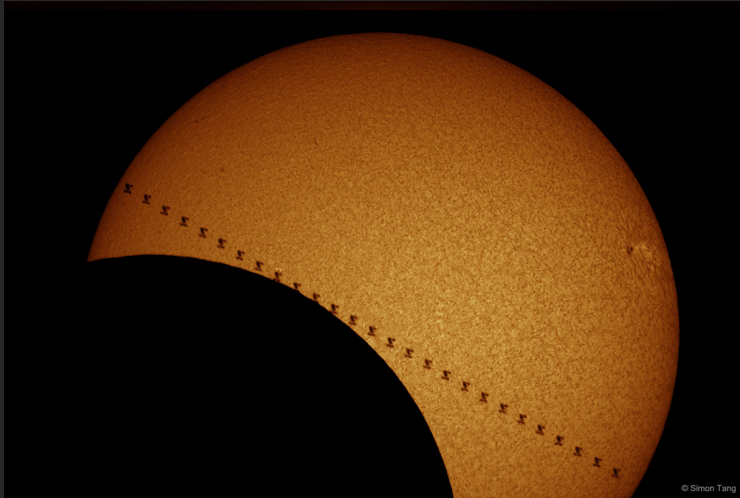# Announcements

- We'll be working through Chapter 2 the next several classes
- If you didn't complete HW1, it isn't too late to still do for most of the credit!
- HW2 will be available today after class. Due 10am on Friday.
- Tutoring is starting up on Sunday
  - Sun-Thur 7:30-9:30pm in the Physics hearth
- Polling: `rembold-class.ddns.net`

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A light-year is approximately:

A. 8 min

B. 365 d

C. 5 AU

D. 9.45×10^{15} m

Hint: the speed of light is 3×10^8 m/s.

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*Hint: the speed of light is 3×10^8 m/s.*

- Stars may only *appear* to be next to one another
  - In reality they may be (and likely are) separated by light-years and parsecs of space
- Stars are so far away that we lose depth perception
  - Think far away headlights at night
- Our eyes could not tell the difference between space as we know it and us living in a huge dark bubble with holes in it to let in light
- Thus we commonly refer to the Celestial Sphere

The Celestial Sphere
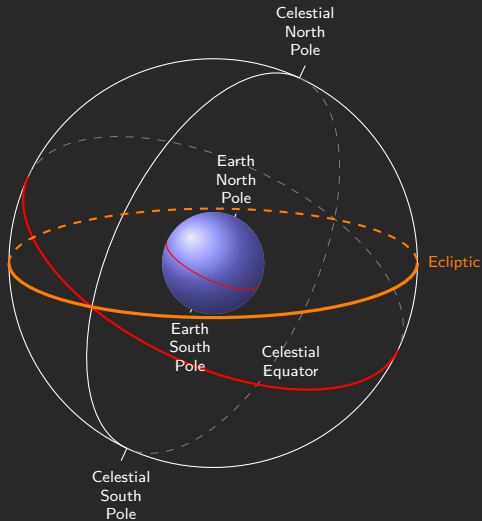
- Aligned with Earth's sphere
  - North and South poles align
  - Equator Aligns
- Equator does not align with the Solar System's disk, because Earth is tilted
  - The ecliptic is the path the Sun (and planets) follow through our sky.
- Like the Earth, positions are denoted with latitude and longitude!
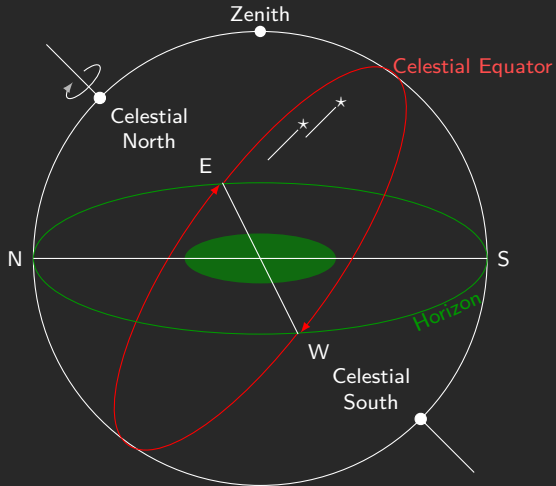 - Commonly called Declination and Right Ascension, respectively.
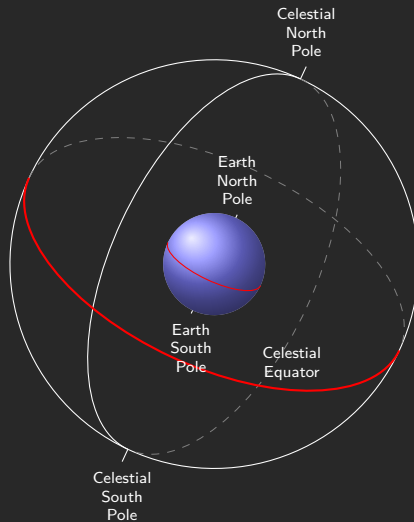
How Things Move: As we see it

- Furthest away: Stars
  - Move along parallel to the Celestial equator
- Closing in: Solar System Objects
  - Move along parallel (and near to) the ecliptic
- Other Objects: Milky Way
  - Galactic plane does not line up with Solar System
  - We see the Milky Way oriented in the sky at yet another angle ($\approx 63°$ from the Celestial equator)
  - Motion follow that of the stars, parallel to the Celestial equator

With everything on a sphere, how do we make measurements?

Making Measurements

With everything on a sphere, how do we make measurements?

- With angles! (commonly called angular distance)
  - Using your outstretched arm:
    - Pinky width $= 1°$
    - 3 middle finger width $= 5°$
    - Fist width $= 10°$
    - Spread hand width $= 20°$ to $25°$
  - We often need to break degrees into smaller increments:
    - 60 arc-minute $= 60' = 1°$
    - 60 arc-second $= 60'' = 1'$
  - Longitude angles sometimes given in hours
    - Earth rotates $360°$ in $24\,h$
    - Thus $1\,h \approx 15°$
  - Angular size related to physical size by the distance away (via trig)

Example

Convert $39°47'32''$ to its decimal representation.

Arc-Time

Example

Convert $39°47'32''$ to its decimal representation.

$$32'' \times \frac{1'}{60''} = 0.533'$$

$$47' + 0.533' = 47.533'$$

$$47.533' \times \frac{1°}{60'} = 0.7922°$$

$$39° + 0.7922° = 39.7922°$$

As long as the angular sizes are small, we can relate angular size and physical size via:

$$\frac{\text{Angular Size}}{360°} = \frac{\text{Physical Size}}{2\pi(\text{Distance Away})}$$

Example

Given that, how far away is the back of the room from the circle on the front board?

Clarification

> **Don't Get Confused!**
> Angular distances are the same using either the Celestial coordinate system or the local coordinate system

- Celestial System:
  - Celestial Latitude (Declination)
  - Celestial Longitude (Right Ascension)
  - Think in terms of the globe
- Local System
  - Direction you are looking (Azimuth)
    - Determined by compass usually
  - Angular distance above horizon (Altitude)
    - Can determine with a sextant or estimate with your hands

Supposed I asked you for the angular diameter of a circle drawn at the front of the room. The students in the front row would measure an angular distance that is _____ the students in the back row.

A. larger than

B. smaller than

C. equal to

D. opposite to

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Example

- How long is the sun up today here on the 45th parallel?
- How long is the sun up today up in Alaska on the 65th parallel?
- How high will the sun rise in the sky for us on December 10th?
- What time will Orion rise on October 31?
- What altitude and azimuth will Vega have at midnight tonight?