Lecture 01

1 Go over the syllabus

2 What is this class about: physics
do not confuse with
astronomy with a lot of fancy pictures

3 Believes vs fact check

Q: Who beleives that Earth rotates and moves around the sun?
Who does not believe!

4. Address Earth rotation around its axis.

Surprisingly, solid proof of it came from the Foucault pendulum in 1851

$$\omega_{\text{plane motion}} = \frac{360^\circ \sin\varphi}{1 \text{ day}}$$

(φ: latitude)

and later with use of gyroscopes

5. Q: Ok. So what do we see when we look at star?

A: they moves seemingly in sync.

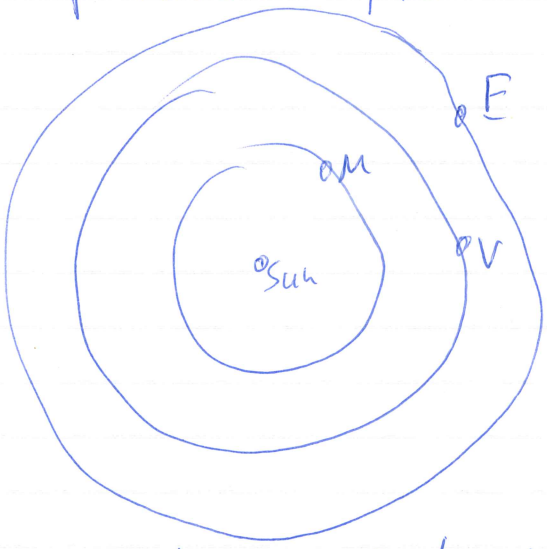
⇒ Earth center of rotation and universe! Geocentric system ⇒ ~~Hipparcus~~

⇒ Hipparcus (150 ~~BC~~ BC)

6. What about retrograd motion?

Ptolemey (100 AD) - epicycles

7. Copernicus (1473–1543) with geleocentric model, published after his death



and so on

Note that Magelan's expedition dates are 1519-1522, i.e. we know that we can loop around Earth

Nice idea. But data does not support it (since perfect circles are no good.

(p3)

Tycho Brahe (1546-1601) the best astronomer of that time critisized Copernicues' model on the following base.

No one see stars parralax while stars appear to have angular size (they did not know about diffraction then). So if we assume that Earth moves, the estimate of star sizes would be huge (larger than Earth orbit) so Sun seems to be a special small star. See 'pdf' link

Note the Brahe angular precision was about 4'

7a. Cassini in mid 1650 observe seasonal variation of the Sun, about 3.4% difference in angular size.
By itself it is not a proof of Earth motion. May be the sun just inflates/deflates with seasons

8. So if one observes a star parallax that would be a nice prove that Earth moves around Sun.

But we need better tools to move beyoun a naked eye resolution of 4'

⟹ telescope by Hans Lippershey in 1608
German-Dutch

Galileo was later (~1609).

Wonderful! Better resolution still no parallax. ☹

But Galileo saw satelites around Jupiter which looks like "miniature" solar system model.

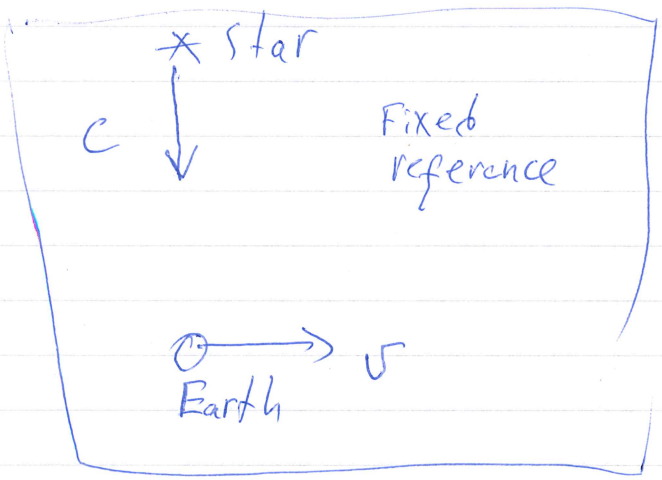
9. Halley (remember the comet?) (1656-1742) in 1718 compared ancient records with current and noticed that stars are moving with respect to each other. So called "proper" motion.

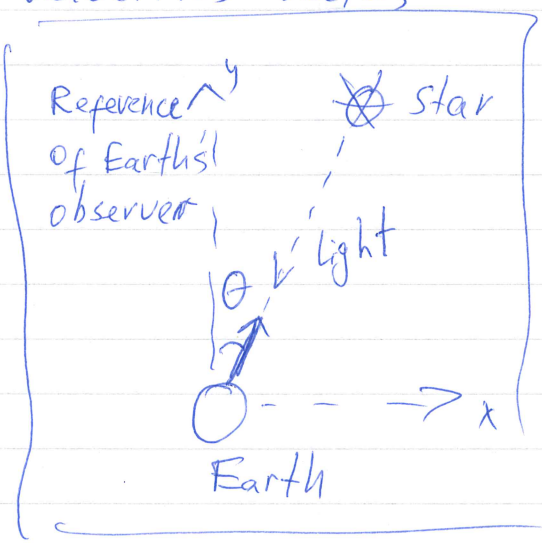
Yet no yearly "loops" in their position observation

10. 1729 James Bradley observe apparent motion of the γ Draconis (Eltanin) done with attachment of a telescope permanent and fixed to a chimney of his house.

The motion was 20".

Can be explain classially (and was by Bradley) as addition of velocities vectors





$\theta = \frac{v}{c}$ | This days we know that Earth moves with $v = 30 \frac{km}{s}$ around the sun and speed of light $c = 3 \cdot 10^8$ m/s

$\theta = \frac{30 \cdot 10^3}{3 \cdot 10^8} = 10^{-4}$ rad $= 10^{-4} \cdot \frac{360^\circ}{2 \cdot \pi} \cdot \frac{3600''}{1^\circ} =$

$\approx 20.6''$ (as observed by Bradley)

But this explanation was disregarded (did not fit those day theories).

11. So it took Bessel to observe the parallax of 61 Cygni (star with the largest known proper motion at that time).

in 1838 he reported 0.314" parallax (modern value 0.348")

on a background of 5.2" of proper motion

So since 1838 we have a solid prove that Earth is not the center of universe and moves around the Sun.