Galileo

Light

- Two people go to two different mountains
- Both have lanterns
- Both groups turn off their lanterns to signal that they are ready for the experiment

Jupiter

- Found the 4 major satellites of Jupiter
- I - Io,II - Europa,III - Ganymede, IV - Callisto (Most cratered object in our solar system)
- Jupiter has an obliquity of its ellipse around 3 degrees (tilt of its axis)
    - No seasonal change
    - Belts
    - Moons appear to move back and forth:
        - Edge on
        - Seeing the orbits perpendicular

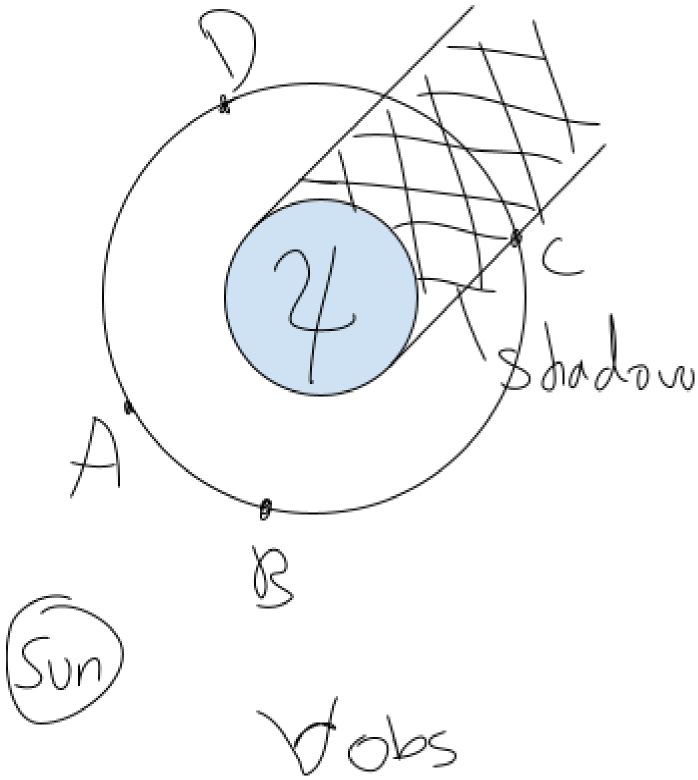
Kepler

- 8 years sorting Brahe's data
- Mars' orbit is sufficiently eccentric that circular orbits could not be made to fit (credit to Brahe's precision)
- Published his work around 1608/9

Kepler's laws of planetary motion

- All orbits are conic sections (ellipse or hyperbola)
    - Circle/parabola in special cases
- Equal areas in equal times
- A planet's period^2 is directly proportional to its semi-major axis
    - Orbits of planets or satellites could now be computed

This view produces phenomena



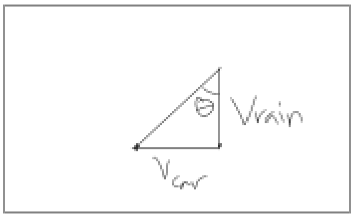
- A, Shadow Transit: Sun → Moon → Jupiter
    - Moon’s shadow falls on the moon, looks like a tiny dark object on the brighter Jupiter
- B, Transit: Earth → Moon → Jupiter
- C, Eclipse
    - Moon runs into Jupiter’s shadow
    - Seen as the moon disappearing
- D, Occultation
    - Jupiter in front of Moon reappearing
    - Can be observed as object reappearing from Moon
- Compute the expected eclipse times, etc. for an observer at the centre of the sun because the math is easier
- For a given observer, prediction times are modified for Earth’s position

Romer

- Noticed that events occurred earlier at A and later at B
- Computed change in distance and change in time and obtained that light travels at 24,000 m/s
    - Low estimate because mean distance to sun wasn’t well understood
    - Measured during Venus transits of 1874 and 1882
    - Radar in 1960
- Most observations based on Io, but people thought that the speed of light was too big and this value didn’t catch on

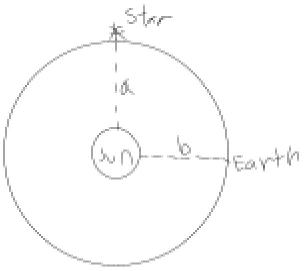
Bradley

Speed of Falling Rain

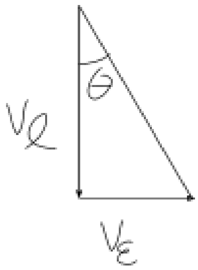


- Suppose V_{car} = 72 km/h = 20 m/s and Θ = 40°
- $V_{rain} = V_{car}/\tan\Theta$
- V_{rain} = 20 / tan 40
- V_{rain} ≃ 23.8 m/s

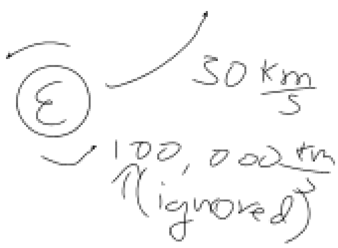
Applying this to stars and planets



- a >>>>> b
- For light, it’s motion:



- $V_l = V_E/\tan\Theta$
- Bradley knew that $\tan\Theta = V_E/V_l$ is really, really small, but had very finely tuned telescopes
    - When the star seemed to appear in a different place, he knew it was because of Earth’s motion (known as stellar aberration)
    - As a result of these accurate measurements, he found that V_l ≃301,000 m/s, which is between ⅓ of a percent of the speed of light
- 1° = 60’ arcminutes
- 1’ = arcseconds
- For Earth, its motion:



- Two pieces of evidence to support V_l to be around 300,000 km/s
- Unsure of stellar or interplanetary media
- Wanted an Earth-based lab to measure V_l

1849 - Hippolyte Fizeau

Version 1: