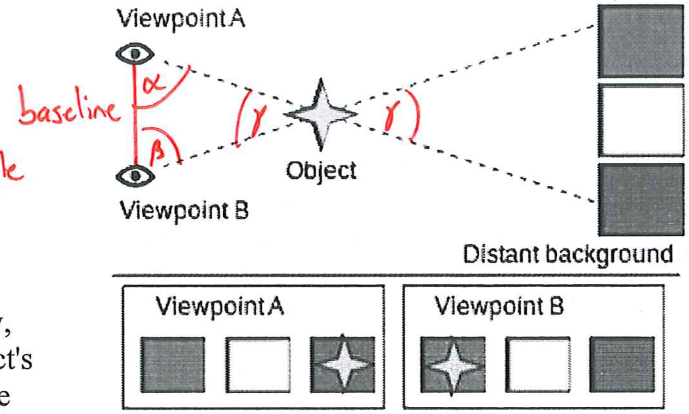
$\alpha + \beta + \gamma = 180^\circ$

$\gamma = 2p$

$p$ is parallactic angle

**INST 2403 Activity**

# Introducing the Parallax




The parallax is an important concept in astronomy, because it allows for the determination of an object's distance by measuring its position. This is possible because of the parallactic effect: an object appears in front of a different distant background when viewed from two different viewpoints (A & B). The distance of the object follows from the geometry of the triangle with corners A, B and object. The distance between A & B is called the baseline. Relative to it, we can measure the angles α at A and β at B. Any triangle of which we know at least two angles and one side is completely determined. In particular, the other sides of the triangle (the distances to the object from A or B) can be calculated.

Stretch out your arm and look at your thumb with your left eye closed, then close your right eye. Repeat with your thumb close to your face.

1. In this exercise, what constitutes the object, the baseline, the background, etc.?

Thumb - object

Baseline – distance between eyes

Background – wall of the room or similar

2. When the thumb is closer to your face, which statement is correct? (Select all that apply.)

a. The thumb is bigger. No, it appears bigger.

b. The distance to the thumb is bigger.

c. The thumb's shift in front of the background is bigger.

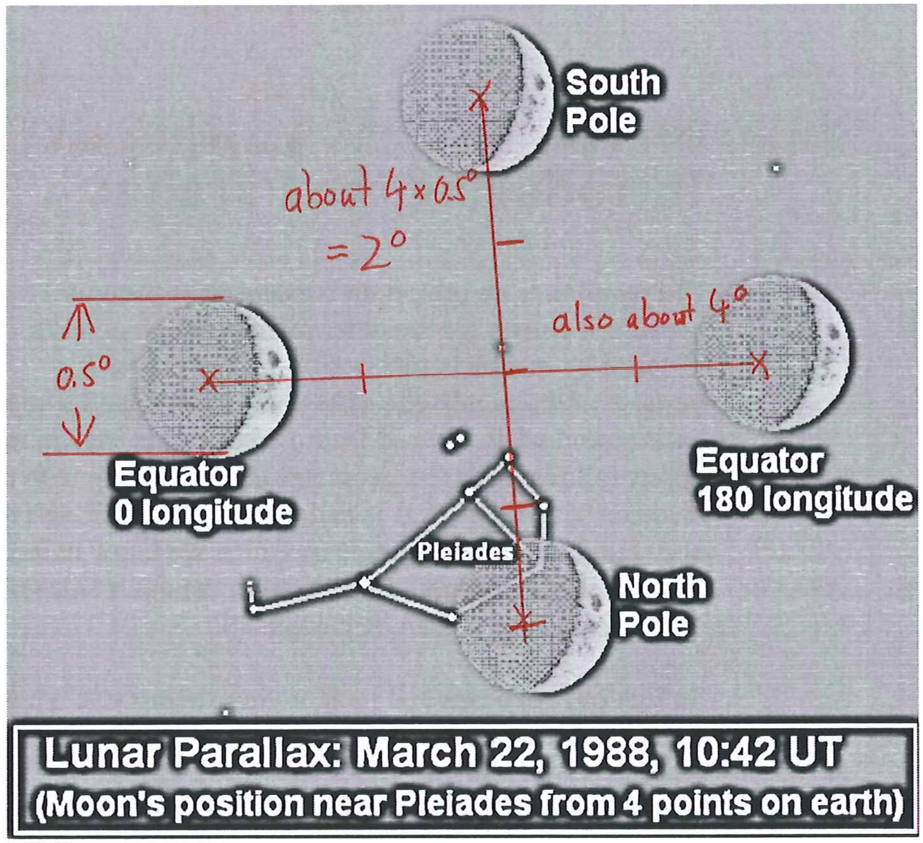
3. In this example you can tell that the thumb is closer, because it appears bigger. Can you use the same argument for astronomical observations, e.g. Jupiter is closer to use since it appears bigger? Explain.

No, Jupiter's size is not known

(To the Greeks even its angular size was not known ("speck of light") )

4. Fill in the blank: the bigger its shift (parallactic angle) in front of a distant background, the smaller the distance to the thumb (or any other object).

The **lunar parallax** shown in Fig. 2.2c of the textbook (reprinted on the right) can be used to determine the distance to the moon. As shown, the moon appears shifted with respect to the stars (here: the Pleiades cluster) when viewed from different locations on Earth at the same time.




5. We know that the moon appears under an angle of 0.5°, so determine the shift of the moon in front of the stellar background when viewed from the North vs the South Pole.

$4 \times (0.5°) = 2°$

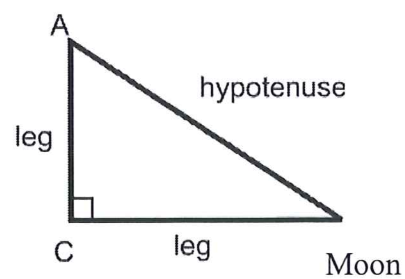
6. The **parallactic angle** is half the angular shift of the object. Here it is: $p =$ 1°

7. The baseline is the diameter of Earth.

8. What is the significance of the fact that the shift from pole to pole is the same as from two points on the equator 180° apart of each other?

The baselines are the same
⇒ The Earth is a sphere.

9. *Using some trigonometry:* We see that $p$ is the angle at the moon in the right triangle pictured below and the leg AC is half the baseline, i.e. the radius $R$ of the Earth. Therefore the hypotenuse is the distance to the moon $D$ and computed by: $\boldsymbol{D = R / \sin p}$
Use $R$ = 6300km to compute the distance to the moon.




$$D = \frac{6300\,\text{km}}{\sin 1°} = \frac{6300\,\text{km}}{0.0174} \approx 360{,}000\,\text{km}$$

(actual: 384,000 km)