ASTR 1020: Stars & Galaxies

February 8, 2008

- *MasteringAstronomy* Homework on The Sun is due Feb. 11th.
- Reading: Chapter 15, Section 15.1.

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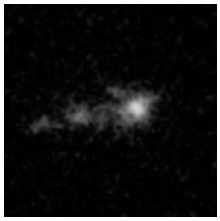
Astronomy In the News



Lindey Maza

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How do we measure the distances to astronomical objects?

- We'll keep asking this question again over the semester.
- Several techniques, each valid for different objects at different distances.
- We need distances to determine luminosities of stars.
- Technique #1: PARALLAX

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Parallax

Measure the apparent movement of stars over a year

Movement is caused by Earth's movement around the Sun

Closer objects will move more than farther objects

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Class demos:

- Your nose is the Sun
- Your left eye is the Earth in January
- Your right eye is the Earth in June

Watch the apparent motion of your thumb against a distant reference point

Which "move" more- closer or farther objects?

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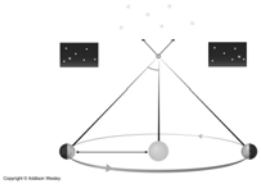
Parallax

Parallactic angle =

HALF of the change in angular position over 6 months

Larger for closer objects

Smaller for farther objects



Movie

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Parallax formula

- Distance (parsecs)

  = 1 / parallactic angle (arcsecond)

Parsec = a unit of distance invented just for this method of distance measurement!

1 parsec = 1 pc = 3.26 light years

Remember 1 arcsecond = 1/3600 degree!

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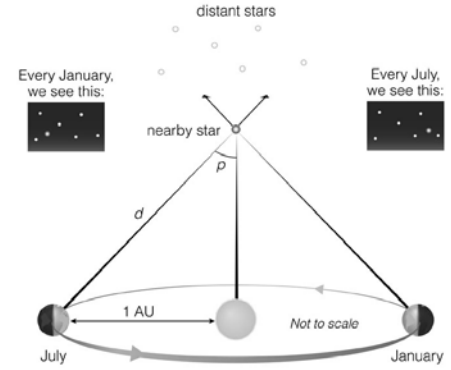

How do we measure distances to stars?

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Parallax and Distance

p = parallax angle

$$d \text{ (in parsecs)} = \frac{1}{p \text{ (in arcseconds)}}$$

$$d \text{ (in light - years)} = 3.26 \times \frac{1}{p \text{ (in arcseconds)}}$$

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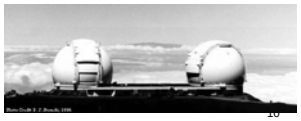
- **Clicker Question:** The biggest ground-based telescopes with adaptive optics can measure a stars' position to accuracies of about 0.05 arcseconds. How far away could they map the positions of stars via parallax?

a) 2 pc = 6.5 light years
b) 20 pc = 65 light years
c) 200 pc = 650 light years



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- **(B)**

maximum distance is set by the accuracy you can measure positions

Distance (pc) = 1 / 0.05 arcsec = 20 pc
= 65 ly

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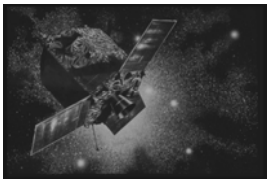
Best parallax measurer: Hipparcos satellite (1989-1993)

- Space measurements not affected by atmosphere
- Measurement made many times until accurate to 0.001 arcsec (→3300 light years)
- 100,000 stars mapped
- (2.5 million to slightly lesser accuracy)



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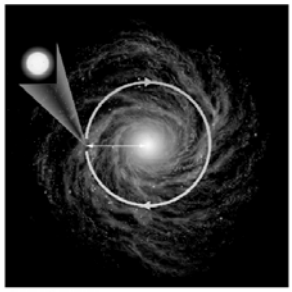
- Center of the Milky Way is about 28,000 light years away
- Parallax works only for nearby neighborhood
- We'll expand to other methods for more distant objects



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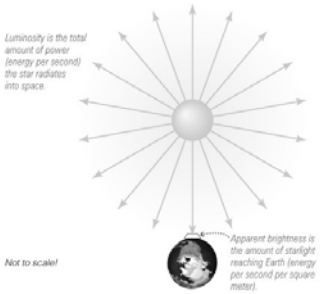
Let's remember that:



Luminosity:

Amount of power a star radiates

(energy per second = Watts)

Apparent brightness:

Amount of starlight that reaches Earth

(energy per second per square meter)

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- Brad and Angelina are two stars that have the same apparent brightness. Brad has a larger parallactic angle than Angelina. Which star is more luminous?

a) Brad
b) Angelina
c) Not enough information. Can't tell.

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- Brad has a larger parallactic angle. Thus, he is closer to us.
- They both have the same APPARENT brightness, but Brad is closer
- B. Angelina must be more luminous.

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Astronomer's Toolbox: What do we know how to do now?

- Measure distance: parallax, good to nearby stars but not beyond
- Measure absolute luminosity:
  measure apparent brightness and distance, infer luminosity

Next: temperature

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