ASTR 1020: Stars & Galaxies

February 6, 2008

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

Fiske Planetarium Show: **Colorado Skies: Celestial Mechanics**, Thursday, Feb. 7th at 8:00 pm.

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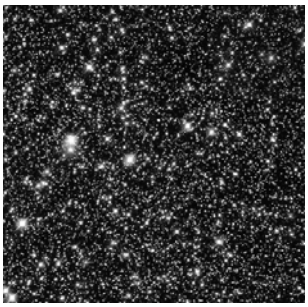
Today's Class: Measuring brightness of the Stars

Measuring apparent brightness of stars.

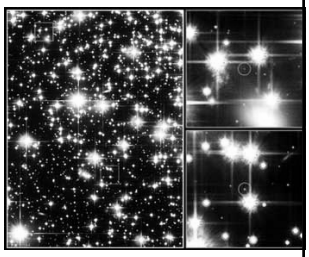
Measuring stellar luminosities.

Magnitudes.



A passive science

- Stars are so small compared to their distance to us that we almost never have the resolution to see their sizes and details directly– "point sources"
- We deduce everything by measuring the amount of light (brightness) at different wavelengths (color, spectra)



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- Stars take millions, billions of years to go through their life stages- we rarely see a single star change
- Observing many different stars lets us figure out the sequence of a single star's life

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- Next few lectures: focus on how we figure out the properties of stars.
- Coming soon: how we deduce the ages and life histories of stars.

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Stellar Luminosity

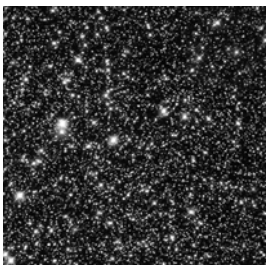
- What we measure: apparent brightness

= how bright it appears to us here on earth

- What we want to know: luminosity

= how much energy is emitted (Joules/sec or watts)

a.k.a. absolute luminosity



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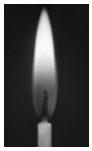
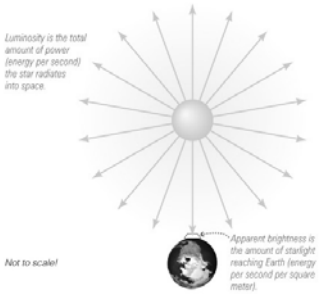
A Big Problem in Astronomy



- A star of a given apparent brightness could be EITHER a very luminous star far away OR a low-luminosity star close

NEED TO KNOW THE DISTANCE TO THE STAR



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)

Clicker Question

These two stars have about the same luminosity -- which one appears brighter?

A. Alpha Centauri
B. The Sun

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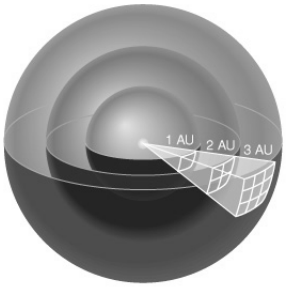
Inverse square law



Luminosity passing through each sphere is the same

The relationship between apparent brightness and luminosity depends on distance:

$$\text{Brightness} = \frac{\text{Luminosity}}{4\pi\,(\text{distance})^2}$$

We can determine a star's luminosity if we can measure its distance and apparent brightness:

$$\text{Luminosity} = 4\pi\,(\text{distance})^2 \times (\text{Brightness})$$

Clicker Question

How would the apparent brightness of Alpha Centauri change if it were three times farther away?

A. It would be only 1/3 as bright
B. It would be only 1/6 as bright
C. It would be only 1/9 as bright
D. It would be three times brighter

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Magnitudes: all you need to know

- Dates back from the original Hipparchus (190 BC).
- Convenient only because it can handle huge ranges in brightness (factors of 10^{12}) via logarithms.
- A kind of ranking of a star's brightness.

Apparent magnitude ZERO is the brightest star in the sky.
Mag 7 is faintest naked eye can see.
Mag 30 = faintest ever really detected.

NOTE THE BACKWARDS SCALE!
Bigger number is fainter!

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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
- Technique #1 for next class: PARALLAX

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