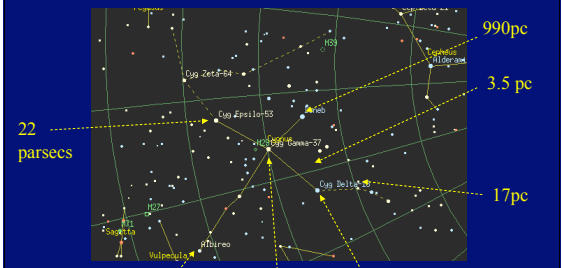
Bright stars and faint stars: the stellar magnitude system



How do we describe the differences in brightness of stars (strikingly obvious when you look at the night sky)?

Modern scientific method: units of power/area

⇨ Demo

the right way to express it

What are units of power in physics?

Brightnesses of Stars: The Magnitude System

The traditional way to describe the brightness of stars…using the human eye as a light detector

Magnitudes, Apparent and Absolute

- Apparent magnitude is the brightness of an object *as it appears to you*
- System due to Hipparchos (2nd century BC)
- Nowadays system made more precise
- Magnitude changes are "logarithmic", each magnitude means factor of 2.512 in brightness
- See Table 16.2 (p382)

Table 16.2…Magnitude differences and brightness ratios

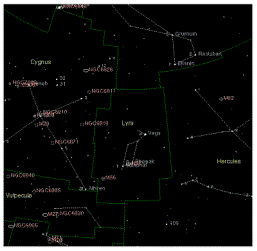
Magnitude Diff.	Brightness ratio
0.0	1.0
1.0	2.5
2.0	6.3
5.0	100.0

Pick a bright (first magnitude) star as m=0, and assign magnitudes to all astronomical objects. Table 16.1

Object	Apparent magnitude
Arcturus	-0.06
Vega	0.04
Altair	0.77
Deneb	1.26
Zeta UMa	2.27
Theta Capricorni	4.07

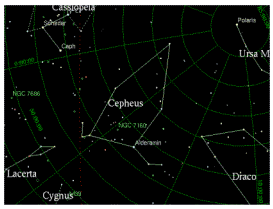
Limit of naked eye visibility: 5.0 - 6.0

Remember, with stellar magnitudes, bigger numbers mean fainter stars! A star with an apparent magnitude of 7.50 is 100 times fainter than a star with a magnitude of 2.50



Two factors determine the brightness (apparent magnitude) of a star

- Intrinsic brightness (luminosity)
- Distance (the inverse square law)



Absolute Magnitude: a measure of the intrinsic brilliance of a star

- Pick a star (any star)
- Imagine moving it to a distance of 10 parsecs
- The apparent magnitude *it would have* is its absolute magnitude
- The absolute magnitude is a distance-independent quantity
- Look at Appendix 12 and Appendix 13 (the brightest stars) and think about the meaning of the absolute magnitudes

Why such a big deal about absolute magnitudes?

- The difference between the apparent magnitude (m) and the absolute magnitude (M) is a measure of the distance to an object

(m-M)	Distance (pc)	Distance (ly)
0	10	32.6
1	15.8	51.5
2	25.1	81.8
5	100.0	326
10	1000	3260
20	100,000	326,000

Say it with equations!

$(m-M)=5 \log(d/10)$!!!

If you know the absolute magnitude M of a star (or other astronomical object) and you measure its apparent magnitude m, you then know its distance. This difference (m-M) is called the *distance modulus*

What are the absolute magnitudes of some stars

Star	M (abs. mag)
Sun	4.8
Tau Ceti	5.8
Altair	2.2
Vega	0.5
Deneb	-6.9
UV Ceti A	+15.3

Apparent magnitude of Jupiter right now: -2.9

Remember: this is how bright they would be if they were all lined up at the same distance

What is the meaning of this **huge** range in the intrinsic brightness (absolute magnitudes) of stars?

Telescopes

The instruments we use to study the universe

More about telescopes

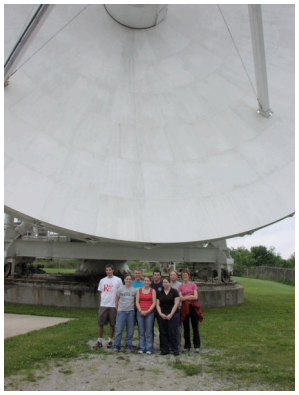
- What you will be looking through later in the semester
- Progress in astronomy would have been impossible without them

Telescopes do two things:

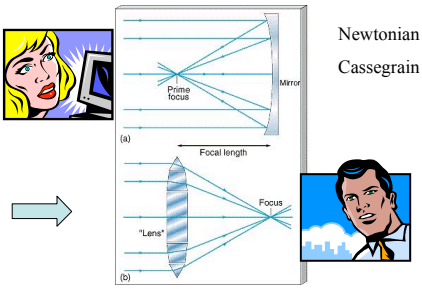
- Collect "Big Piles" of light
- Magnify object (it looks a lot closer than it is)

Types of Telescopes

- Refractors
- Reflectors
- Radio telescopes
- None of the above



Reflectors and Refractors



Newtonian

Cassegrain