ASTR 1020: Stars & Galaxies  
March 19, 2008

• Reading: Chapter 20, sections 20.3.
• Meet Friday at Fiske Planetarium – Hubble’s Expanding Universe (bring your clicker)

Today’s Class

• Chapter 20:
  • Galaxies
  • Mapping the Universe: measuring distances to galaxies

A Universe Full of Galaxies

• Galaxies are classified into basic types
• Use both shapes and star properties
• Sizes range from giants, through biggish (like the Milky Way), through dwarfs

Spirals ~80% of galaxies

• Disks (spiral arms)
  AND
• Spheroids (central bulges + halos)

• Some have “bars” across the centers
Elliptical ~15% of galaxies

- Round or slightly flattened
- Very little cold gas (no 21-cm emission), dust, or young stars
- Reddish/yellow color = old stars (red giants, red main sequence)

Dwarf ellipticals

Most common type of galaxy?
- Only know nearby ones (faint!)

Irregulars

- Galaxies in formation?
- Or Transition?
- Often LOTS of star formation!

Where they live

- Spirals– mostly in groups (3-10 galaxies)

The Big Picture- the universe is filled with a network of galaxies in groups and clusters

- Ellipticals– more often in dense clusters of galaxies (100’s – 1000’s)
- Why? Chapter 21...

A dense Galaxy Cluster
Mapping the Universe: We need Distances to Galaxies!

So far—Parallax

New methods: standard candles

1.) Make some measure of an object which identifies its luminosity

2.) Use this luminosity and measure apparent brightness to infer distance to it

1.) Main sequence fitting

• Start with a cluster distance known via parallax (upper)

• Compare with other clusters (lower)

• Which is more distant— the upper or lower?

2.) Cepheid Stars

• Region on the HR diagram with large, bright stars

• Outer regions are unstable and tend to pulsate

• See Chapter 15: pulsating variable stars

• Star expands and contracts, getting brighter and fainter

• Period = one whole cycle

Cepheid Stars

• Period-luminosity relationship

• Overall brighter Cepheids have longer periods

(elephants and hummingbirds)

• Clicker Question: Two Cepheid stars, Fred and Barney, have the same apparent brightness. Fred has a period of 5 days, and Barney of 10 days. Which is closer?

a) Fred
b) Barney
• A) Fred

• Fred has a shorter period and so must be less luminous (hummingbird)

• Less luminous but the same apparent brightness means that Fred is closer to us

Cepheids as Standard Candles

• Measure period of variability

• From period-luminosity relation, infer the luminosity

• Compare with apparent brightness and determine distance