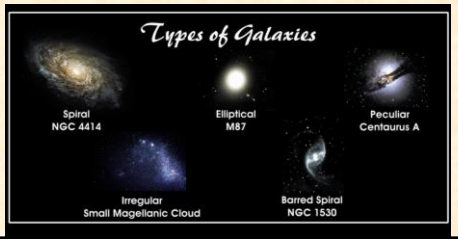
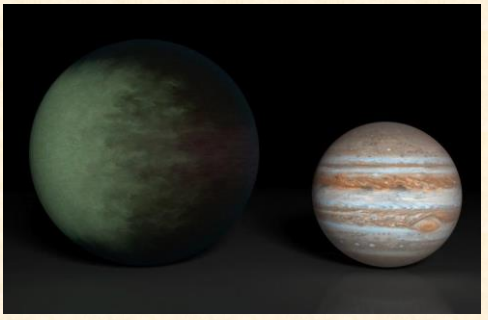
ASTR 1020: Stars & Galaxies

November 1, 2013

- Reading: Chapter 20, Section 20.3
- *MasteringAstronomy* Homework on The Milky Way is due tonight at midnight.
- Meet next Wednesday at Fiske Planetarium for *Hubble's Expanding Universe.*



Astronomy in the News:
First Cloud Map of a Planet Beyond Our Solar System
Cristian Landa



Kepler-7b (left), which is 1.5 times the radius of Jupiter (right), is the first exoplanet to have its clouds mapped. The cloud map was produced using data from NASA's Kepler and Spitzer space telescopes.

Today's Class

Chapter 20:

- Galaxies
- Mapping the Universe: measuring distances to galaxies

UKS 17

Reading Clicker Question: Which of the following is **NOT** a key difference between elliptical and spiral galaxies?

A. Elliptical galaxies are seen at greater distances from the Milky Way.
B. Elliptical galaxies contain less dust and cool gas than spiral galaxies.
C. Elliptical galaxies are redder than spiral galaxies.
D. Spiral galaxies have more young stars than elliptical galaxies.
E. Elliptical galaxies are generally smaller than spiral galaxies.

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A Universe Full of Galaxies

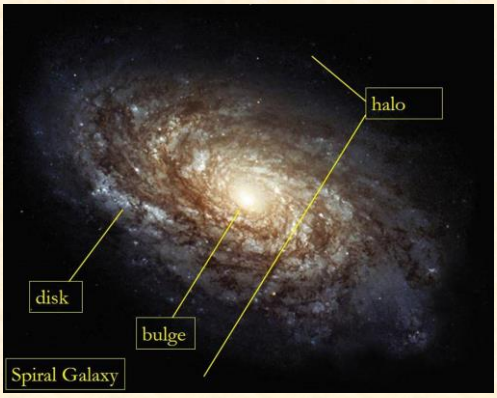
- Galaxies are classified into basic types.
- Use both shapes and star properties.
- Sizes range from giants, through biggish (like the Milky Way), through dwarfs.

Spirals ~80% of galaxies

- Disks (spiral arms)

AND

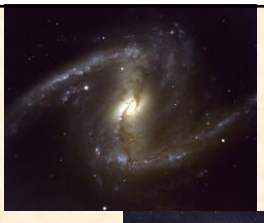
- Spheroids (central bulges + halos)



Disk component:
stars of all ages, many gas clouds

Spheroidal component:
bulge and halo, old stars, few gas clouds

- Some have "bars" across the centers

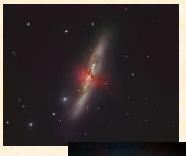


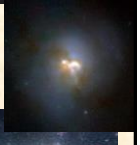
Elliptical ~15% of galaxies

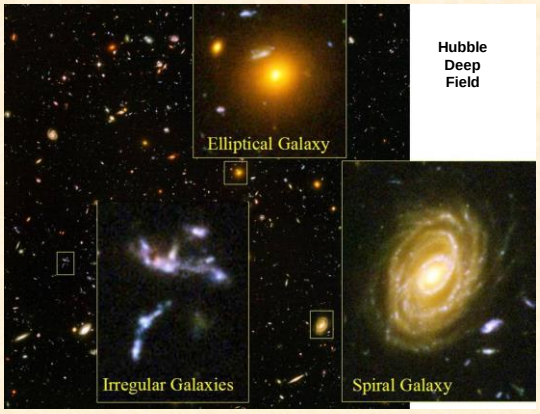
- Round or slightly flattened
- Very little cold gas (almost never any 21-cm emission), dust, or young stars
- Reddish/yellow color = old stars (red giants, red main sequence)

Irregulars

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







Where they live

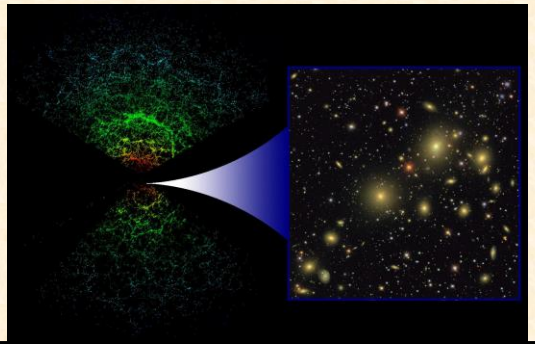
Spirals– mostly in groups (3-10 galaxies)

Ellipticals– more often in dense clusters of galaxies (100's – 1000's)

- Why? Chapter 23…

A dense Galaxy Cluster

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



Mapping the Universe: We need Distances to Galaxies!

So far– Parallax

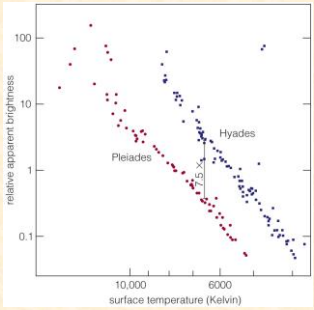
New methods: standard candles

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

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

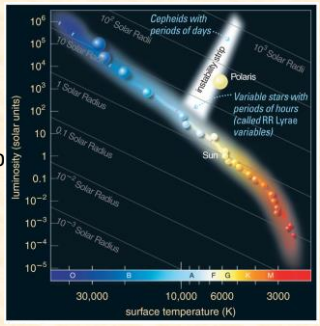
1.) Main sequence fitting

- Start with a cluster distance known via parallax (upper)
- Compare with other clusters (lower)
- Which is more distant- the upper or lower?

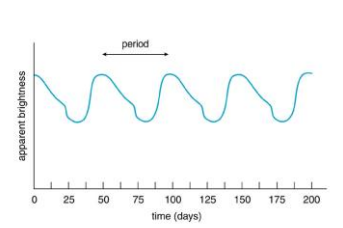


2.) Cepheid Stars

- Region on the HR diagram with large, bright stars
- Outer regions are unstable and tend to pulsate
- See Chapter 15: pulsating variable stars



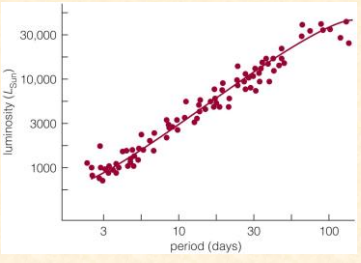
- Star expands and contracts, getting brighter and fainter
- Period = one whole cycle



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