Astronomy 16 – Modern Astrophysics
Fall 2014
Week 14

We'll discuss galaxies and their range of properties, how we determine their distances, and the Hubble law – the evidence for an expanding universe. Along the way, we'll go back to pulsating stars (and their use as distance indicators – standard candles – and also to the virial theorem, which enables us to infer the total mass of a self-gravitating system from its kinetic energy.

So, there's a primary reading assignment posted below, with a few pointers for things to pay special attention to. But there's also a very small amount of additional reading from chapters we've read earlier in the semester. Please do that reading, too.

Topics:

Different types of galaxies and their properties
Masses of galaxies
Distances to galaxies
The Hubble law and the expanding universe

Reading:

Read Ch. 20 for Tuesday. Also, go back and re-read sec. 17.3 on pulsating stars. Pay special attention to the period-luminosity relationship (and the basic physical explanation for it on p. 405). Also, go back to the end of Ch. 3 and read about the virial theorem, paying special attention to the final result (eq. 3.87).

A few things to note as you're reading Ch. 20:

As you read the first two pages of the chapter, think about the period-luminosity relationship of pulsating stars (like Cepheid variables) and make sure you understand how it can be used to find the distances to galaxies.

In what ways are elliptical galaxies like the halo of the Milky Way?

Notice how small, how numerous, and how close by the smallest galaxies (dwarf irregulars) are.

What are the properties of a starburst galaxy? Why are they so bright in the infrared? Why should galaxy interactions or mergers cause a burst of star formation?

How do we use the virial theorem to measure the masses of galaxies?

What is the evidence for supermassive black holes at the centers of galaxies?

What are the desirable properties of a *standard candle* and what are the current best standard candles?

Be sure you understand how the velocity-proportional-to-distance trend implies a uniformly expanding universe. (Why wouldn't it be a uniform recession velocity distribution?)

How can the measured Hubble constant be used to infer an approximate age for the universe? And how would that age estimate change if gravity has been continually slowing the expansion rate since the big bang occurred?