

Topics: Galaxies – and measuring their distances; the Hubble Law

Reading:

- Read the beginning of Ch. 20 and the first three paragraphs of sec. 20.1, then skim the rest of sec. 20.1.
- Read the first two pages of sec. 20.2, through the end of the paragraph that contains eqn. 20.8, and skim the rest of the section.
- Read secs. 20.3, 20.4, 20.5
- Look over the slides posted on the website in the same paragraph as the assignment link.

Summary of work to submit:

- Nothing to hand in for this class.

The three broad topics we'll discuss are:

(1) Galaxy properties and classification (spirals vs. ellipticals): note that in some sense elliptical galaxies are like the haloes of spiral galaxies (but without the bulge and disk). In other words, ellipticals are relatively gas-free with only old stars and those stars orbit on “plunging orbits” – with very high eccentricity – leading to a spherical distributions of stars with little net angular momentum. Spiral and irregular galaxies have gas and star formation (and so a population of younger, bluer stars).

(2) Distances to galaxies (§20.4) – make sure you understand what a *standard candle* is in the context of distance determinations using the inverse square law. The period-luminosity relationship for pulsating variable stars (see Fig. 17.7 on p. 404) is a classic technique, where the measured period (again, Fig. 17.7) is used to infer the luminosity of the star (so that a flux measurement gives the distance via the inverse square law). Figuring out that galaxies were really very far away (and thus very big – like the Milky Way) was a milestone achievement of the early 20th Century.

(3) The other major consequence of being able to measure/estimate the distances to galaxies was the discovery of a correlation between a galaxy's distance from us and its redshift – the Hubble Law of the expanding universe (§20.5). This discovery was the gateway to cosmology, the study of the universe as a whole. Equation 20.30 is one of the most important equations in astronomy. Are you comfortable with the idea that a constant (uniform) expansion leads to a situation where velocities aren't the same everywhere but rather are proportional to the distance between the observer and any given galaxy that's moving away from them? OK with the units of the Hubble constant, H_o ? And with the idea that the Hubble constant's value gives us an estimate for the age of the universe?