Astronomy 16 – Modern Astrophysics

Fall 2014

Week 9

Stellar evolution is interesting, but complicated. We'll focus on the basic, physical principles and interesting phenomenology.

Topics:

Binary stars and stellar masses
Star formation
Stellar evolution
Stellar pulsations

Reading:

We'll start by finishing up binary stars (end of Ch. 13). They're important for (at least) four reasons: (1) they're by far the best way to weigh a star; (2) the techniques used to study them are also used to study exoplanets; (3) they're common and so if we're to understand how star formation works we need to understand why so many binary star systems are formed; (4) binary affects stellar evolution, as mass can be exchanged between stars when one or both star goes through the red giant phase (or other phases of expansion and/or mass-loss).

To prepare for the discussion/wrap-up of binary stars, play around with the binary system simulators I've linked to from the front of the class website.

We'll move on to stellar evolution itself from binary stars.

Read all of Ch. 17, but we won't get to 17.3 on Tuesday.

Important concepts and related facts to keep in mind as you re-read, and make sure you can answer while/after you've done the reading. We will discuss all of these in class this week.

From last week:

What different types of binary stars are there? What can and can't we observe for each type? And what trends are found among the major observable properties of (most) stars?

This week:

For Sec. 1 of Ch. 17, the key concept is the *Jeans mass* and the battle between gravity and pressure. When will a cloud collapse under its own gravity? Pay attention to the relevant timescales. How long does it take a cloud to collapse (and form a star)? Notice how the optical thickness of the cloud matters – is a cloud more or less likely to collapse if the heat created can't escape?

For Sec. 2, notice how important the location of the nuclear fusion (core vs. "shell") is in the resulting structure of the star; that's in addition to whether H to He fusion or fusion of some heavier elements is the primary energy source. The phenomenon of electron degeneracy pressure is important (and will be important when we study white dwarfs). What are the key differences between low- and high-mass star evolution?

For Sec. 3, try to explain pulsational instability to yourself in simple physical terms. What role does opacity play? The period-luminosity relation turns out to be a super-useful tool for finding distances to pretty far away objects (via the inverse square law).