AST 301 – Scalo—Reading and Study for Exam 4

Exam 4 covers chapters 17 (properties of stars) and 18 (the interstellar medium); we are postponing 19 because of timing--it will be included on the next exam).

By now I assume you know what types of questions at the end of the chapters or at the online questions are relevant for exams; basically try them unless they concern a topic we aren't covering (only a few such things—see below); just don't worry much about numerical problems, except for the simplest of them (see below).

Because there is so much information there, the exam is weighted toward Chapter 17—more than half the exam questions are on this chapter.

It will probably help if I summarize here a few things about each chapter.

Chapter 17

1. Don't spend much time trying to completely understand "proper motion," "tangential velocity" and how they, along with radial velocity, give the "space" (i.e. total) motion, but I do expect that you have read that section of the text and know what the terms mean. I just want you to understand that a star's velocity has two components that have to be measured using different techniques.

2. Discovery 17-2 on the Hipparcos Mission. You should read it to appreciate how this unglamorous space mission has really revolutionized our estimates of distances. I will probably ask a question about it, but don't worry about the details, i.e. the list of specific discoveries or its size or things like that. But remember, today, almost all parallaxes are from Hipparcos.

3. In sec. 17.3, don't read about "The Magnitude Scale" or the "More Precisely" on p.446 about this topic, unless you want to; i.e. it isn't on the exam. When you see "apparent magnitude" just think "apparent brightness."

4. Concerning spectral types, memorize the letters OBAFGKM as a decreasing temperature scale, and try to understand why the most prominent spectral lines are different in each class (Table 17.2). If someone said "Spectral type B (or K or any spectral class) star" you should be able to tell them something about their properties.

5. You SHOULD read the "More Precisely 17-2" on p. 451. Even though it is rather mathematical, it is important to understand it, because it is essentially the only way we can estimate the diameters of most stars. It is also covered in the class notes.

6. In sec. 17.6, we only discussed "luminosity class" briefly in lecture, but you should read about it, just to understand that we can tell, for example, giants from main sequence stars using their spectra.

7. In sec.17.7, the main thing to understand is that it makes sense that Kepler's 3rd law as modified by Newton allows us to get masses of stars in binary systems, but you should mostly know the results. What is the range of masses of main sequence stars (in solar units)? Where (along the main sequence) are the most massive stars? Least massive? What is the mass of a very red star on the main sequence? What is the mass-luminosity relation and how does that tell us something very important about how the lifetimes of stars depends on mass?

Be sure you understand how knowledge about the masses of stars, and their luminosities, allows us to estimate their lifetimes..

Chapter 18

This chapter isn't long, but be sure you read it thoroughly. It mostly has some great pictures, but also gives you an inventory of the gas and dust structures that are observed between the stars, and how they appear and why. The importance here is that stars actually do form from this "interstellar medium", and that is the subject of the following chapter. So we are studying the very earliest phases of the formation of the stars, especially when we discuss the densest interstellar gas/dust structures (what are they?) Also remember that these various types of regions (HII regions, dark clouds, emission nebulae, etc.) are often the same region, just observed in different ways, or observed in the dust rather than the gas, or else depending on whether a massive young star is nearby. You should understand that previous sentence by the time you are ready for the exam.

Don't worry if you don't understand "polarization" (p.471) and how that tells us the shapes of dust grains—I think it is too difficult a concept given the time we have. Concerning the "emission nebulae" (sec.18.2), I just want you to know why a gas cloud near a hot star would appear this way, and to appreciate it as a real-life example of the emission line physics we discussed in Ch.4. (Also, considering that it requires a hot star, why do you expect most emission nebulae to trace out the regions where the youngest stars reside in space?) Don't worry about "forbidden lines" unless you are interested—you would have to have a course in quantum mechanics to really understand it, so I will not ask about "forbidden lines" on the exam. But DO read 18.3, 18.4, and 18.5, as well as Discovery 18-1 (UV astronomy and the "Local Bubble"—they are short, and important.

Sample questions on next page.

Here are a few sample questions. If you have studied and understand the material, you should feel comfortable giving the correct answers.

1. If we know the apparent brightness of an object, its luminosity may be calculated if we also know its ____________.
a) distance b) radial velocity c) surface temperature d) mass

2. If a star has a parallax of 0.05 seconds of arc, then its distance in parsecs is:
a) 0.05 b) 5 c) 2 d) 20 e) 200

3. The radius of a star can be estimated if the ___________ and ___________ of the star are known. (Assume no other information is available.)
a) parallax and spectral type b) temperature and luminosity
c) mass and temperature d) mass and luminosity

4. A certain star is observed to have a surface temperature of about 20,000K and a luminosity equal to the sun's luminosity. From this we can infer that the star is
a) more massive than the sun. b) less massive than the sun.
c) probably a young star. d) probably a white dwarf.
[Can you explain this in words?]

5. A spectroscopic binary is one in which
a) we can see both stars and obtain the spectrum of one of the stars.
b) the Doppler effect is used to infer that a star is a member of a binary.
c) the inverse square law is used to obtain the sum of the masses.
d) the spectral type of one or both of the stars is used to infer its luminosity class, and hence estimate its distance.
e) the spectral type of one or both of the stars is used to estimate their temperatures, and hence place them on the H-R diagram, allowing mass to be estimated from the mass-luminosity relation.

6. Most spectral lines of interstellar molecules are in the __________ part of the spectrum.
a) ultraviolet b) visible c) infrared d) radio

7) About how far away is the most distant star for which we know the trigonometric parallax accurately? (There is no unique answer here, but there certainly is a best answer.)
a) 1 pc b) 50 pc c) 200 pc d) 3000 pc e) 100,000 pc

8) Emission nebulae like the Orion Nebula occur only near _____ stars.
a) red supergiant b) red main sequence c) massive d) old
[Try to exlain "to someone" why each of the incorrect choices are in fact incorrect.]

9) The most abundant molecule in a molecular cloud is:
a) NH_3 (ammonia) b) CO (carbon monoxide) c) H_2O (water) d) H_2