Astronomy 123 – Stars and Stellar Structure
Fall 2002
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Scope of Class:

This is an advanced class on stellar astronomy. Though we'll learn about stellar structure, it's no more important than stellar atmospheres, formation, evolution, etc. I think the name of the class is supposed to represent an emphasis on theoretical understanding.

We have a very good and quantitative understanding of *stellar* astrophysics, especially compared to other branches of astronomy. Stars are the most ubiquitous naked-eye cosmic source of light (even excluding the sun). Stellar astronomy is the most mature subfield of astronomy, with a lot of different basic physics principles applied to its understanding.

Stars are the engines for processing elements – nucleosynthesis – in the universe; they generate tremendous explosions and put out a prodigious amount of energy; they have a strong influence over the interstellar medium and the galaxies in which they reside. And stars are not static, they are born, live, and die, with their deaths often triggering the formation of new stars.

The study of stars incorporates and combines a lot of interesting physics: gravity and radiation, atomic physics, nuclear physics, thermodynamics. We will take a quantitative, theoretical approach to understanding the nature of stars and the life cycle of stars. But we will also continually connect this understanding to observational data and look at specific applications and problems in research articles, including some classic articles that first discussed specific phenomena.

Schedule:

1. Introduction, Radiation, and Stellar Properties – Ch. 3
2. Binaries and Masses – Ch. 2 and Ch. 7.
3. & 4. Interiors – Ch. 10
5. & 6. Stellar Atmospheres, RT – Ch. 8. Ch. 9, Rybicki & Lightman
7. Midterm
8. & 9. Evolution, Remnants – Ch. 13 and Ch. 15
10. & 11. Winds – Lamers and Cassinelli, Stan's encyclopedia article
12. Star formation and angular momentum evolution
13. Student presentations/special topics

This is tentative, of course, at this point. We'll flesh out the reading assignments and the specifics of the topics as the weekly assignments are distributed.

Texts: Our main text will be *An Introduction to Modern Stellar Astrophysics* by Ostlie and Carroll. They have a website with errata at http://astrophysics.weber.edu/Corrections_to_14.html

There will be supplemental texts on the honor reserve shelf in Cornell. These include:

- *The Physical Universe* by Shu (an introductory astro text, but at a pretty advanced level)
- *Principles of Stellar Evolution and Nucleosynthesis* by Clayton (quite advanced, mathematical, and complete text on the physics of the insides of stars)
- *Introduction to Stellar Astrophysics* (vols. 1, 2, 3) by Bohm-Vitense (graduate level, but a bit idiosyncratic)
- *Allen's Astrophysical Quantities* by A. Cox (lots of data about stars; and theoretical results, trivia, etc.)

I will be adding other texts to the shelf as the semester progresses.

We will also, from time to time, read and discuss research papers and review articles. I will always try to connect them to the more straightforward material in the text book(s).

Weekly Assignments: Our agenda will generally be built around the material in the textbook, but I will try to augment this with other sources, including research papers. I will sometimes assign presentations to each student, but often, especially when the problems are less open-ended, everyone will be responsible for answering or leading a class discussion.

Some or all of each week's problems will be neatly written up and handed in on the Friday after seminar. Note that it should be relatively easy to get very good grades on the problem sets if you understand what we discuss during our seminar meetings. I will not always grade every handed-in problem, but I will always provide solutions.

I like multi-part problems, often following up numerical calculations with questions about concepts or applications to real data or information in research papers. I like a good explanation. I like neat, thoughtfully considered graphs and diagrams. I like variables to be labeled with units.

Exams: We'll have a midterm (in lieu of a regular class on Wednesday, October 23). It will be a three-hour, probably closed book, take-home exam. We'll also have a final exam in the same style. You can each decide which day to take the final.

Projects: You'll each do some outside research and give a 20 to 30 minute presentation on a topic of your own choosing the last week of classes.

Grades: They will be determined from approximately the following breakdown:

Problem sets: 40%
Midterm: 20%
Final: 25%
Participation and snack quality: 5%