

ASTR 472: Stellar Atmospheres & Spectroscopy
Fall 2016
Tuesday 2–5 pm, LL 211

Instructor:

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office hours: walk-in anytime or by appointment

Course Objectives:

- Describe how to measure the properties of binary stars and/or exoplanet host stars using Doppler shifted spectra;
- Measure the temperature structure of the Sun's atmosphere from observational data;
- Calculate a simple model of the flux emitted by a star;
- Model the production of spectral lines in a stellar atmosphere;
- Write a research paper about how astronomical spectroscopy can be applied to other scientific questions.

Textbook:

Required textbook: *Interpreting Astronomical Spectra* by D. Emerson

Other helpful texts:

An Introduction to Modern Astrophysics by Carroll and Ostlie

The observation and analysis of stellar photospheres by David F. Gray

Theory of Stellar Atmospheres by Ivan Hubeny & Dimitri Mihalas

Rob Rutten's course notes on radiative transfer

(available online at

www.staff.science.uu.nl/~rutte101/rrweb/rjr-edu/coursenotes/rutten_rtsa_notes_2003.pdf)

The Fundamentals of Stellar Astrophysics by George W. Collins

(available online at <http://bifrost.cwru.edu/personal/collins/astrobook/>)

Atomic Spectroscopy by W. C. Martin and W. L. Wiese

(available online at <http://www.nist.gov/pml/pubs/atspec/index.cfm>)

Stellar Atmospheres by J. B. Tatum

(available online at <http://orca.phys.uvic.ca/~tatum/stellatm.html>)

Grading:

Homework – 75%

Research Paper and Presentations – 25%

Attendance is strongly recommended but not required. Every assignment must be turned in to receive a passing grade for the course. Late homework will be penalized by 10% per day late, without a valid excuse. If you have a valid excuse, we will agree upon a reasonable deadline to complete the work.

Academic Integrity:

All work must be the individual's own work. Copying from other students or outside sources is considered plagiarism, and it will not be tolerated. I do not mind if you use outside references on homework assignments; there are many resources available to help you learn the material. Outside references (other than the class textbook) must be properly cited if used on any assignment. Any student found to have engaged in academic misconduct on a graded assignment or exam may be assigned a zero for that assignment, assigned an F in the course, and/or reported to the Dean of Students.

Accommodations for Students With Disabilities:

If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

Tentative Schedule:

- Aug. 30: Introduction to stars, spectral types
- Sept. 6: Measuring fundamental parameters with binary stars
- Sept. 13: Instrumentation
- Sept. 20: Thermodynamic equilibrium
- Sept. 27: Atomic structure and spectroscopic notation
- Oct. 4: Introduction to radiative transport
- Oct. 11: Radiative transfer and stellar atmospheres
- Oct. 18: **Pacing break; no class**
- Oct. 25: Statistical equilibrium
- Nov. 1: Sources of opacity and line profile shapes
- Nov. 8: Line profile shapes, cont.
- Nov. 15: Line formation, curve of growth
- Nov. 22: Applications of spectroscopy: stars, stellar winds
- Nov. 29: Other applications of spectroscopy
- Dec. 6: **Research papers due; Student presentations**

This syllabus is only a tentative outline of the course. The grading policy, dates, or the topics covered in class may change as needed.

Research Papers and Presentations:

Each student will research one application of spectroscopy discussed in our text: active galactic nuclei (AGN), the interstellar medium (ISM), or the solar corona.

For your research paper, use the material in the textbook (chapters 6, 7, 8, or 11) as a starting point, and formulate a narrow scientific question for further consideration. Perform a journal search to learn more about the current state of affairs on your chosen question. Your research paper should present a summary of that narrowed topic, written for an audience of professional astronomers. You may assume that the reader is familiar with all content from our class notes and assignments, and you should discuss relevant theory and/or observations as appropriate for your topic.

The research paper should have 1-inch margins on each side, 12-pt font size, and single line spacing. The paper should be 5–6 pages long (excluding supporting figures, tables, and references). You should cite at least 5 external sources, which should include mostly recent, refereed journal articles. (Recent means < 10 years old!) Please use the citation style recommended by *The Astrophysical Journal* (see their Author Guidelines online).

Students will give a 20 minute presentation on their research topic at the end of the semester.