Astronomy 410 — Radio Astronomy, Fall 2007

Meeting place and time: CSS 2428, TTh 3:30 pm — 4:45 pm

Instructor: A. Harris, CSS 1229
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Office hours: You are encouraged to make an appointment or just drop by!

Astronomical observations at radio wavelengths are a vital part of the study of nearly any object in the universe. Radio astronomy plays a key role in discovering and understanding objects as diverse as the Cosmic Background Radiation, the huge jets of relativistic matter from the nuclei of luminous galaxies, ionized gas around young stars, pulsars, diffuse clouds of hydrogen atoms orbiting in galactic gravitational potentials, dense molecular clouds with embedded star formation, evolved stellar atmospheres, the Sun, and the planets. This course is an introduction to the basic physics, instrumentation, and observational targets of radio astronomy. This is an upper-division course that assumes some background in basic physics (waves and E&M in particular) and mathematics (calculus, vector analysis, simple differential equations).

Course work includes twice-weekly lectures, approximately weekly take-home problem sets, a midterm, a cumulative final exam, and a term paper or project with topic to be decided by mutual agreement with class members and the instructor.

Course grading and the grade distribution are set by:

Item	Weight
Homework	30%
Midterm	20%
Final	30%
Term paper or project	20%

Grade	% Total
A	90-100%
B	80-90 %
C	70-80 %
D	60-70 %
F	<60%

The exams will be rescaled (only upward if necessary) for an 85% class median. Experience shows that this is an A/B class for most students. Grading will use the plus/minus scheme linearly interpolated within each grade.

Problem sets are due at the beginning of lecture on the due date. Late problem sets will be accepted for 80% credit up to one lecture past due, but no credit will be awarded after that. Working the problems is useful in any event, since some of the exam questions will be very familiar to those who have done the problems.

The course textbook is *A student's guide to Fourier transforms, Second Edition* by J.F. James for some of the mathematical background, a paperback from Cambridge University Press, ISBN 0-521-00428-4. Higher level recommended books are *Tools of Radio Astronomy* by Rholfs and Wilson and the classic *Radio Astronomy* by Kraus. Since there is no text at the right level, we won't be following a text exactly, so lecture attendance and note-taking are important.

The University regulations apply strictly regarding academic honesty and excused absences. Students with a documented disability who wish to discuss academic accommodations should contact me as soon as possible.

Astronomy 410, Fall 2007

Approximate schedule

Th, Aug. 30	Introduction; sources of radio waves
Tu, Sep. 4	Overview of detection schemes: direct and heterodyne
Th, Sep. 6	Heterodyne radiometers I: amplification and noise
Tu, Sep. 11	Mathematical tools: Fourier series and transforms
Th, Sep. 13	Heterodyne radiometers II: frequency conversion (Football mess?)
Tu, Sep. 18	Spectrometers
Th, Sep. 20	The overall receiving system; the radiometer equation
Tu, Sep. 25	Antennas: diffraction in single dishes and interferometers
Th, Sep. 27	Antennas: wire antennas, single dishes, optics, and feeds
Tu, Oct. 2	Antennas: interferometry and aperture synthesis
Th, Oct. 4	Antennas: interferometry and aperture synthesis
Tu, Oct. 9	Practical observing and coordinate systems
Th, Oct. 11	Radiation: energy, power, flux density, Janskys, and all that
Tu, Oct. 15	Radiation: spectra revisited; radiative transfer, optical depth
Th, Oct. 18	***Midterm***
Tu, Oct. 23	Galactic continuum radiation: The Galaxy and other galaxies
Th, Oct. 25	Galactic continuum radiation: Synchrotron emission, cosmic rays
Tu, Oct. 30	Galactic continuum radiation: Free-free emission and young stars
Th, Nov. 1	The Interstellar Medium: Temperatures and line formation
Tu, Nov. 6	The Interstellar Medium: Neutral and ionized hydrogen
Th, Nov. 8	The Interstellar Medium: Molecular clouds
Tu, Nov. 13	Galactic dynamics
Th, Nov. 15	Stars and the Sun
Tu, Nov. 20	Pulsars
Th, Nov. 22	*Thanksgiving break*
Tu, Nov. 27	Radio galaxies, quasars, and active galactic nuclei
Th, Nov. 29	Cosmology: discrete sources
Th, Dec. 4	Cosmology: dust continuum and protogalaxies
Tu, Dec. 6	Cosmology: cosmic microwave background
Th, Dec. 11	Special topics
W, Dec. 19	***Final Exam, 10:30-12:30 (as scheduled by University)***